THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXI. No. 1832.] LONDON, JUNE 21, 1898. [50TH YEAR. PRICE 6d.

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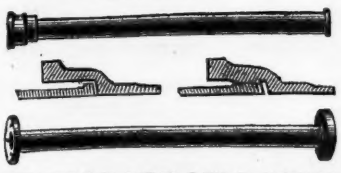

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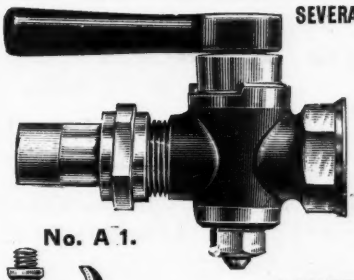

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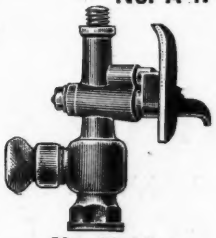

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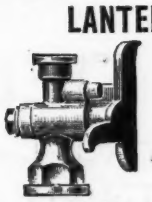

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Fig. 705. "SINGLE RAM" STEAM-PUMP.

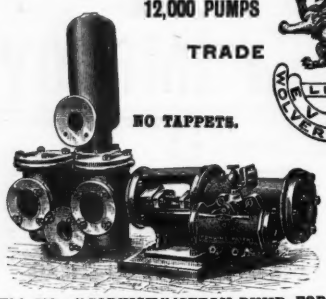

Fig. 596. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

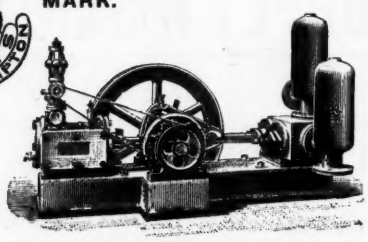

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

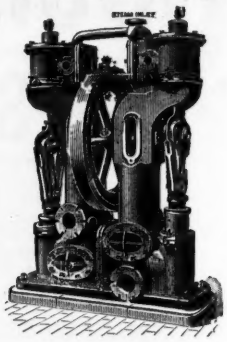

Fig. 712. "DOUBLE-RAM" STEAM-PUMP.

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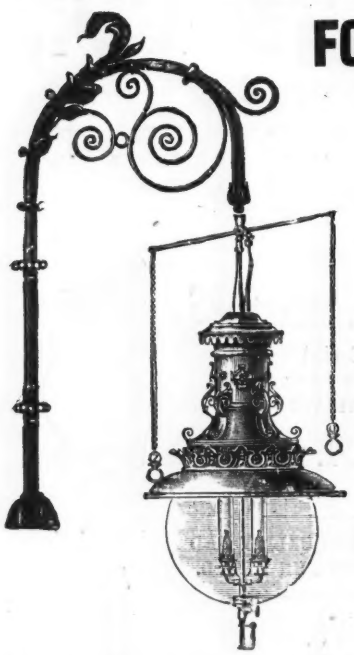

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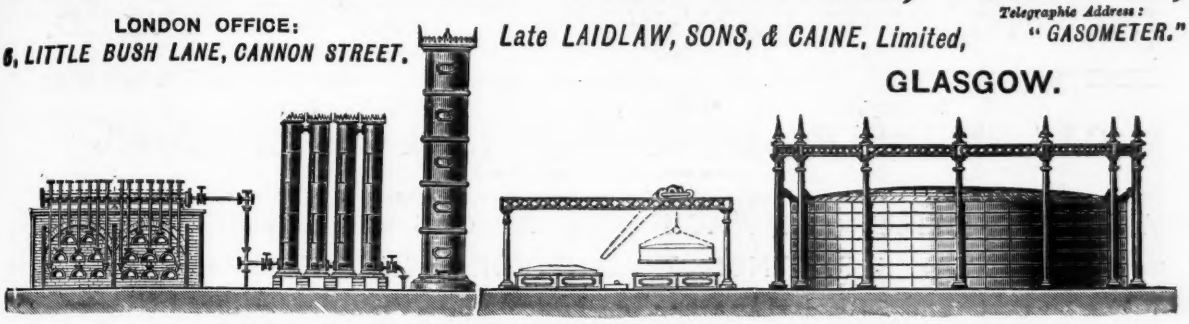

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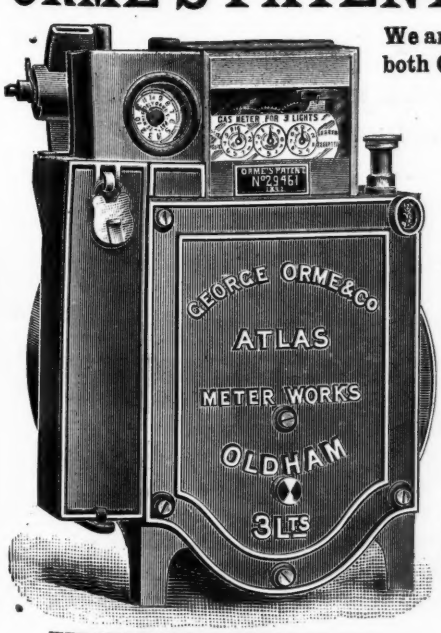

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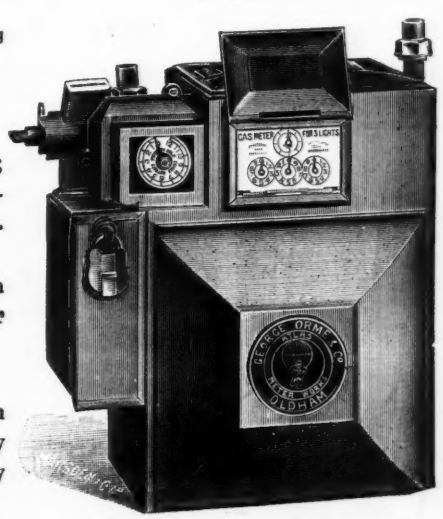

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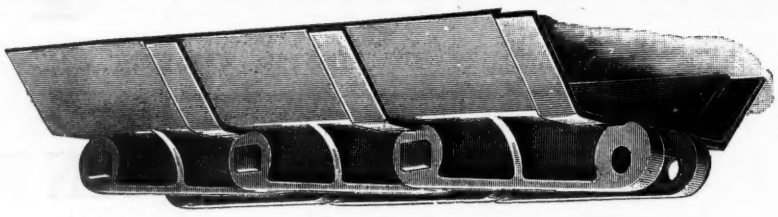

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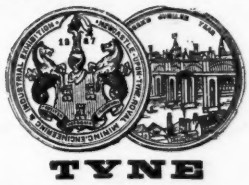

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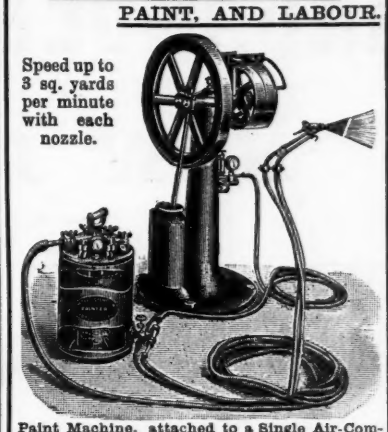

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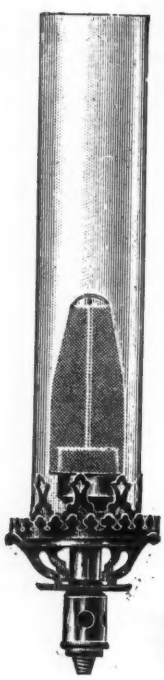

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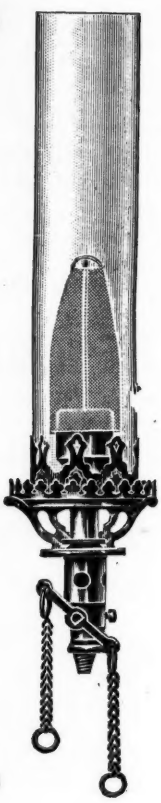

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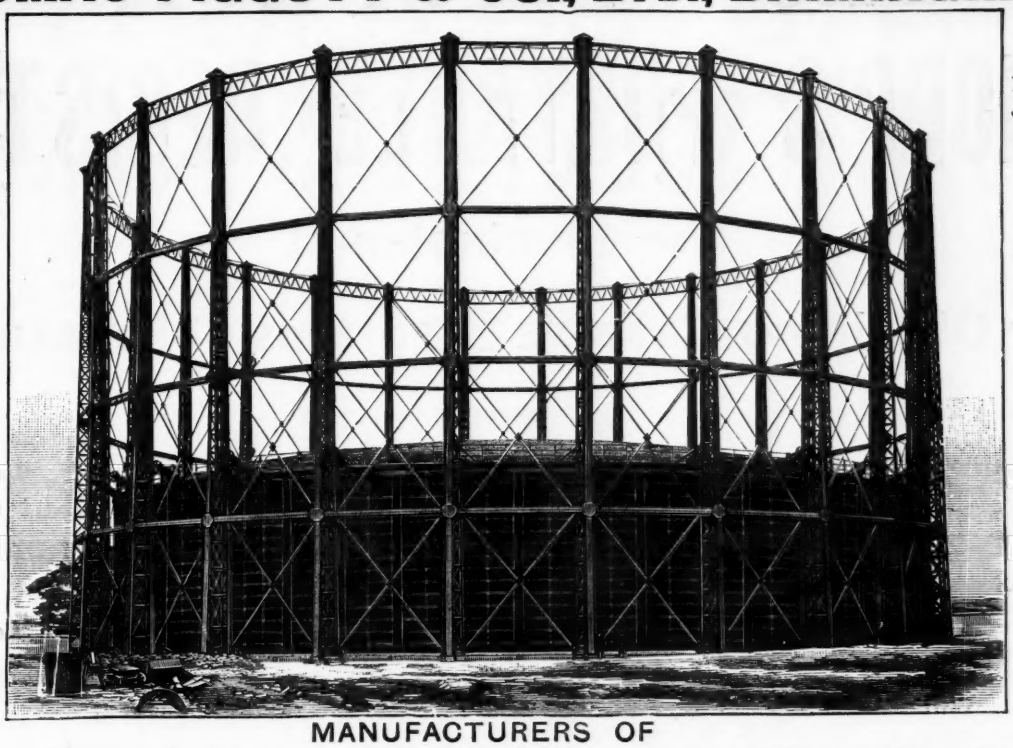

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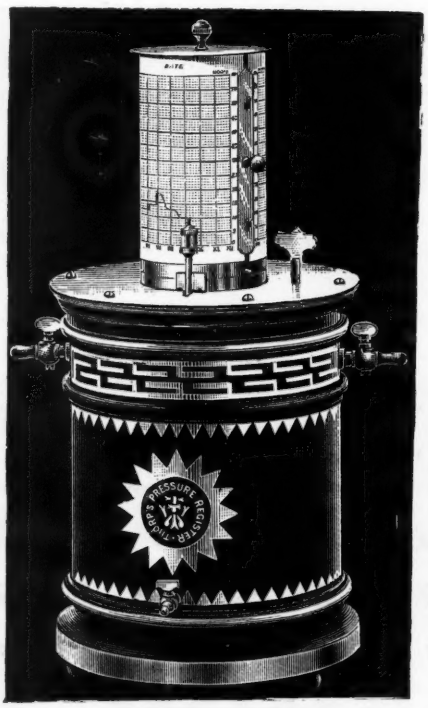

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4-in.	,,	2-in.	exhaust
3-in.	,,	3-in.	,,
8-in.	,,		
6-in.	,,	2-in.	,,
4-in.	,,	4-in.	,,

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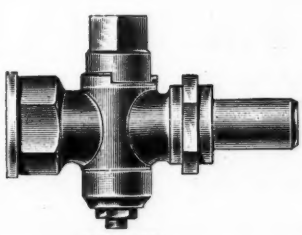

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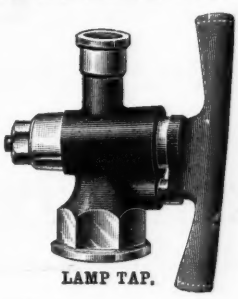

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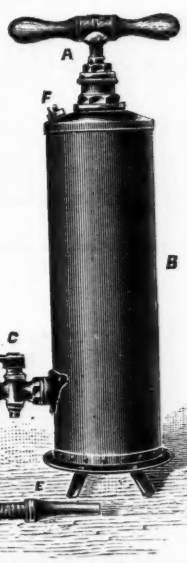

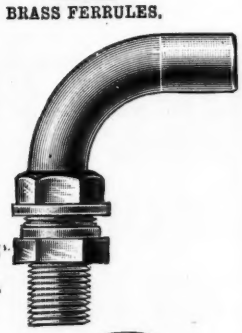

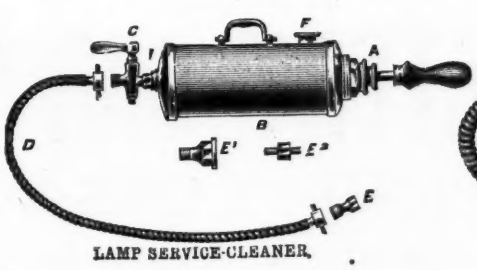

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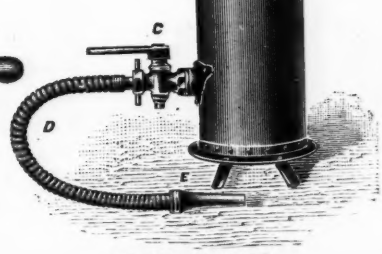
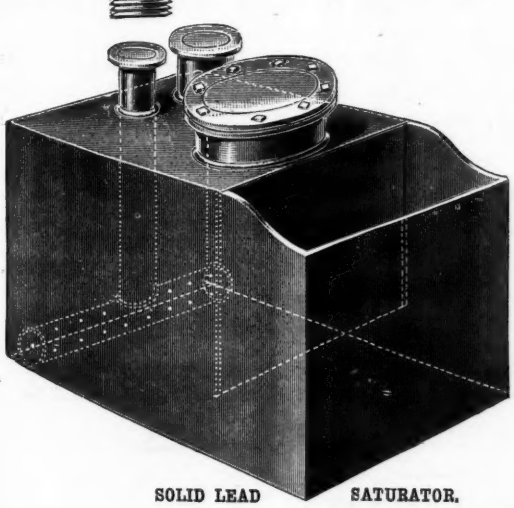
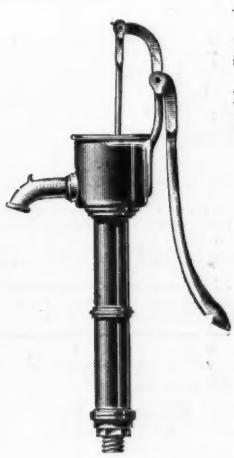


SERVICE CLEANER



SOLID LEAD SATURATOR.



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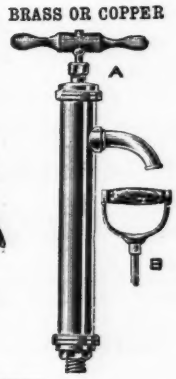

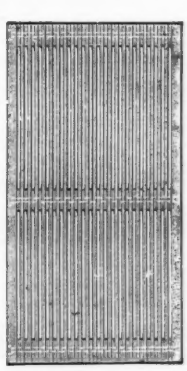

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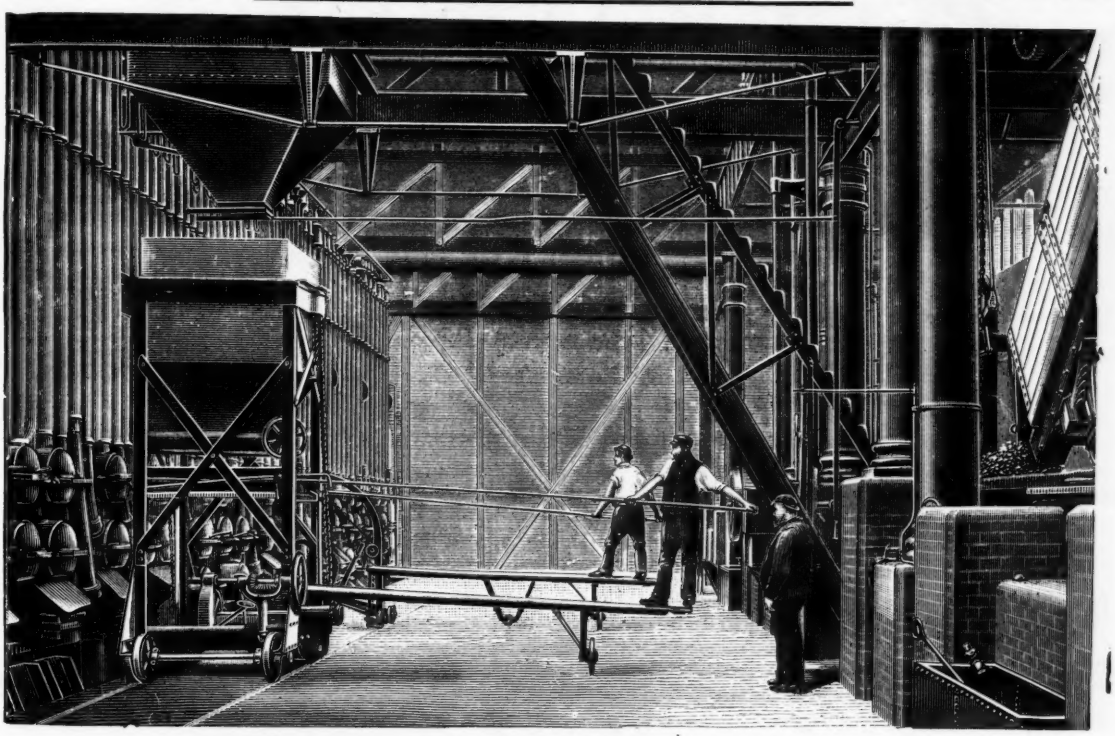

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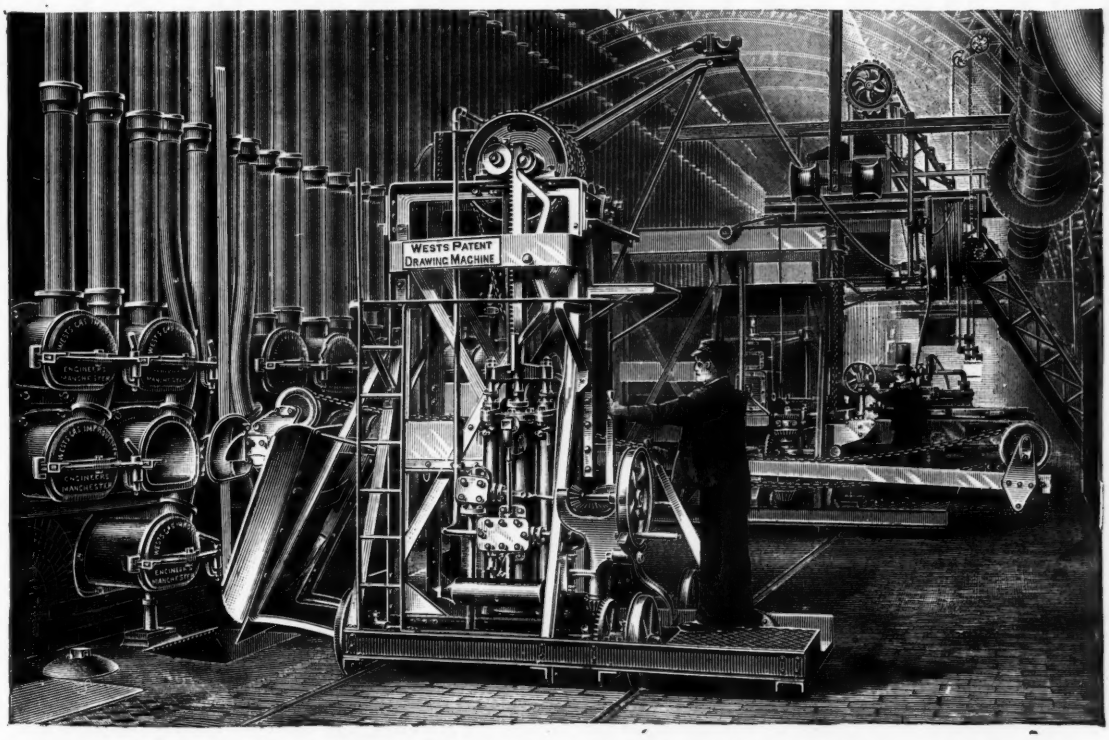

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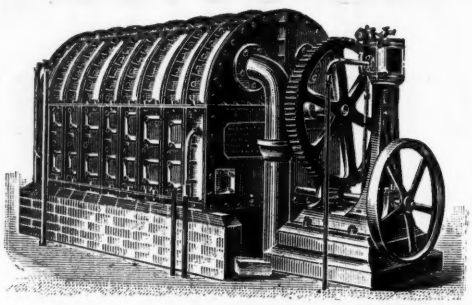

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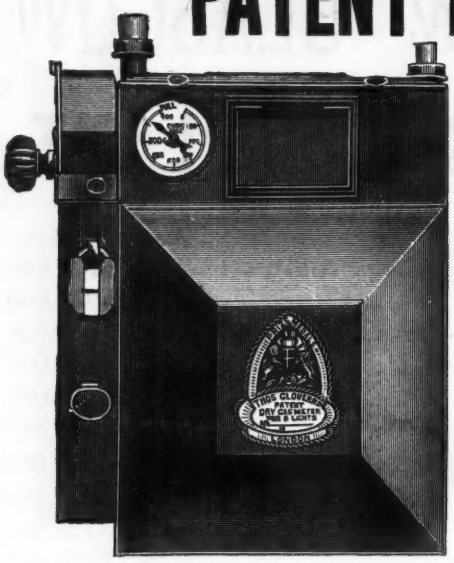

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EDITORIAL NOTES.

The Meeting of the Institution of Gas Engineers.

ONE word best describes this year's meeting of the Institution of Gas Engineers—it was eminently "businesslike." The papers read fell naturally into groups—or rather, it should be said, into pairs—which raised definite questions of living interest for all practical gas engineers; and these topics were well and faithfully considered, both by the authors of the papers and by speakers in the discussions. Several times speakers were heard to testify that they were helped towards the solution of some pressing problem of practice by what they had gleaned at the meeting; which is one of the highest encomiums that can be passed upon the working of a technical society. It is, indeed, what such organizations exist for; but in too many cases the object is not attained. The past week's meeting was gratifyingly successful in procuring the envisagement of some of the most important and immediate of the technical questions that await solution by every individual gas manager, according to his lights; and also in brightening these lights. The President, Mr. George E. Stevenson, contributed to the proceedings an address which, while it may not command universal acquiescence on every point, was just such a candid statement of personal thoughts and observations upon matters of professional interest as might very fittingly come from the executive head of a great gas undertaking. The presidential conduct of the business of the meeting was of a piece with the whole proceedings. If discussion at times descended into conversation, as it did rather more frequently than a strict formalist would have permitted, the purpose that actuated everybody—the elucidation of facts and the registering of considered opinions—was ample excuse for the apparent laxity.

For the information of those not present who may desire to know in a few words what the meeting did, we can state that it passed in review the practices of gas distribution, gas photometry, and coal carbonization, and put upon record some pertinent observations upon one or two other points of gas management. More practical discussions we have never heard at a technical gathering. Not a single word was wasted; and the elements of "padding" and of personal advertisement were wholly absent. This is a great thing to say of any professional congress; but it is true of this one. The meeting justified itself many times over; and the Institution may take credit for having once more set the high-water mark for technical papers and discussions in the English language. It is hardly necessary to state that, whether at work or in play, it also maintained a standard of self-respecting conduct which one could wish universally observed by similar organizations.

An interesting feature of the meeting was the reception accorded to the Dutch Gas Engineers, in return, though not in requital, for the splendid hospitality extended to the members of the Institution on the occasion of their pilgrimage in the past autumn. Considerations of number only prevent the extension of this practice of international courtesy, the fashion of which was set by the Anglo-French meetings of former years. The Dutchmen are representatives of a people "great only in renown;" but still, as members of a technical organization, they bulk as largely as the resources of the Institution are competent to deal with. It is gratifying to know that the members and the governing body of the Institution rose to the occasion, and—the former by their generosity, and the latter by their administrative ability—discharged all the obligations incurred during last year *sub consule* Woodall.

The Publication of the Proceedings of the Institution of Gas Engineers.

IN connection with the practice of the Council of the Institution of Gas Engineers with regard to the reporting of the proceedings of the annual meetings, we desire to offer here a few observations which we separate from our notice of the transactions of the recent meeting, because they are of general application. There is no intention, moreover, to qualify the appreciation already expressed of the character of last week's gathering, by uttering a complaint of something which was not peculiar to that meeting. The circumstance of the Council being upon the point of making an important change in the secretarial arrangements of the Institution supplies the opportunity for re-opening the question of reporting, which, with the matter of publishing the "Transactions," has never been placed on a satisfactory

footing. How many of the ordinary members of the Institution, upon whom the Council must rely for the necessary supply of papers for the annual meeting, are fully aware of, and approve, the unwritten conditions attaching to their contributions: (1) That the authorized reproduction of the papers, with the accompanying drawings and diagrams, will not take place for a whole year. (2) That the technical journals of the industry, which would give world-wide publicity to matter of this kind within a week or two, are not permitted to reproduce any of the diagrams supplied to the Institution for the purpose of being exhibited to explain the text? Somebody—was it the President?—speaking at the Institution dinner, declared it to be a chief function of the technical Press to "compel publicity" of technical matters by the disclosure of which knowledge is increased. Must it be taken to be a main object of the Council of the Institution to prevent this publicity, by deliberately consigning what is often the most instructive portion of the technical communications confided to the Institution, to the "decent obscurity" of the volume of "Transactions," which only appears a year after date? If this is the object, it is certainly admirably attained by the present practice. Who looks at the volumes of society "Transactions"? Who does not look for the first reports of meetings in the Press, which serves up this intelligence best and freshest?

This is a subject which calls for the earnest attention of the Council. It is difficult to understand what good purpose is intended to be served by putting any obstacle whatever in the way of the fullest publication of reports of society meetings by every journal that is desirous of presenting its readers with this intelligence. As Dr. Clowes remarked at the Institution dinner, one of the most successful Societies in the world of science and industry—the Society of Chemical Industry—thrives much more by its "Journal" than on account of any other advantage it is able to offer to its members. What are the old-fashioned, fossilized, unfruitful Societies? Those that adhere, in a bustling age, to the primeval practice of burying their papers in a heavy annual volume of "Transactions," which comes out late, costs a lot of money, and goes straight into the bookcase. We do not say that such volumes are wholly useless. On the contrary, if those who receive them can depend upon the editing being of a quality commensurate with the time appropriated to the work of preparation for the press, and if the illustrations and tables are on a scale and of a style of execution worthy of a book of reference, those who desire, for any purpose whatever, to look the matter up will be glad to know just where it can be found in really trustworthy shape. But such volumes are useless for keeping active men, students, and men of affairs, posted as to what the Societies are doing at the moment. This latter is precisely what the technical Press is for; and how those Societies which do all they can to muzzle the Press, without having means of quick publication of their own, can reconcile such a policy with the reason for their own existence, is a puzzle.

We offer these observations on the obscurantism of the Council of the Institution of Gas Engineers partly in defence of the "Journal," which is debarred by it from doing the authors of papers the full honours of world-wide, prompt publicity. Reputation is the only return the Institution offers to those who present its meetings with technical communications; and it is a poor way of paying the obligation to hide away the drawings. Why do the thing by halves? Why not forbid publication of the text of the papers, if the idea is to keep something of peculiar value for the "Transactions"? Why admit reporters, and permit the discussions to be published at the discretion of the Press, general and technical? Perhaps the bearings of the question of publicity have never been grasped by the Council. Mr. Stevenson will have the opportunity for distinguishing his year of office by modernizing the Institution in this regard.

The Forthcoming Report of the Petroleum Committee.

There has been a good deal of newspaper comment during the past week, after the fashion of the times, upon the contents of the unissued report of the Petroleum Committee. Our newspapers are nothing if not "previous;" and in catering for the public demand for news, they find it advantageous to anticipate the event rather than be a few hours behind it. With regard to the inquiry of the Petroleum Committee, it is rather curious to observe how a distinct flavour of party politics has by some means become attached to the apparently neutral question of the proper flash-point for burning oil. The impeachment of the present flash-point has, for some occult reason, been taken in hand by the Radical and Progressive party. The attack upon the flash-point was led in the first instance by the representatives of the Scottish shale oil interest; but it was warmly supported by the majority of the London County Council, and by some people up and down the country who have persuaded themselves that the Standard Oil Company ought to be trounced for sending us so much oil. Most of the newspapers professing "advanced" views have joined in the cry against the "deadly low-flash-point "oil;" and so the cause has prospered—in print, at any rate—mainly through the advocacy of those who did not know anything at all about the facts. Such is the way of political causes in general. In the case of the report of the Petroleum Committee, it has transpired that this body has been sharply divided into a majority which does not accept the proposition that the actual flash-point is the cause of lamp accidents, and a minority which is for raising the flash-point to 100° Fahr. The two parties were led by the Chairman (Mr. Jesse Collings), and Mr. Ure, the member for Linlithgow, each of whom drafted a report. Mr. Collings's draft commanded the adhesion of the majority of the Committee. It is stated to proceed, in the main, upon the view that the need for altering the flash-point was not proven by the evidence; but that a remedy for lamp accidents should be found in improving lamps upon the lines laid down in evidence by Mr. Wright, the President of the Lamp and Stove Trades Association.

In arriving at the conclusion that no case has been made out for raising the flash-point, Mr. Collings relies upon the evidence of the witnesses who testified that lamps reasonably well constructed and used with a fair amount of care are safe for all ordinary oils. At the same time, the Chairman thinks that improved legislation is desirable, in the interest of public safety, in regard to the storage, transport, and sale of burning oil. It appears to be taken for granted that raising the flash-point to 100° Fahr. would mean dearer oil, while it might not necessarily mean a safer illuminant. The alternative report of Mr. Ure is stated to ignore the question of lamp construction altogether as an element in lamp accidents, which is strange if true. The most ardent enthusiast for high flash-point oil might be supposed to be willing to admit that the design and material of a lamp has something to do with its safety or otherwise; but it is certain that so much feeling, and prejudice, has crept into the discussion of this subject on the side of the partisans of high-flash oil, that their views of the issue are hopelessly distorted. Meanwhile the scare about the deadly low flash-point is being exploited by the oilmen as a means of getting a higher price out of the public for a class of oil which there is only their word to show is not the same as that against which they inveigh. Once get a high-flash oil prescribed by law, and the efforts of the local inspectors to catch the wily retailers of margarine for butter will be as child's play to those that will be needed to cope with transgressors against the new ordinance. A fresh army of inspectors, paid out of the rates, would be called for. More inspection; more prosecutions; more espionage—and all for a cause in which those who have studied the facts most, believe least.

The New Gases of the Atmosphere.

The new means of research into the nature of things placed at the disposal of science in the entity of liquid air, have already been fruitful of startling disclosures. It is not so long ago that the world was profoundly interested in the disclosure by Lord Rayleigh and Professor Ramsay of the fact that there were other things in its atmosphere than had been dreamt of by the current philosophy. Then came the improved appliances which turned air and everything contained in it, in gaseous form, into liquid—not in single drops, but literally by the bucket full. Professor Ramsay and his henchmen plunged into the new "element" as though to the manner born; and about three weeks ago they fished out another new component of the atmosphere, naming it "krypton" because of the remarkable success it had achieved in hiding itself from human ken ever since the beginning of the world. Scarcely had the French Academy and the Royal Society made room for the new comer, than the same indefatigable explorer demanded hospitality for something else of the

nature and character disclosed by the following passage taken from "The Times" of last Friday. Professor Ramsay and Mr. Travers having put a large quantity of argon through the processes of separation, liquefaction, and fractional distillation, came at last to something which differed spectroscopically and otherwise from all known gases. "On continuing the distillation, after nearly the "whole of the liquid argon had evaporated, a solid was "obtained which only slowly volatilized. The gas into "which this solid was converted was found to be of prac-"tically the same density as argon, but its spectrum was "altogether different and peculiar, consisting for the most "part of bands, not of lines. It is proposed to call the "lighter element 'Neon,' and that derived from the solid "'Metargon.'"

These disclosures cause one to ponder. Since the dawn of modern science, men have been occupied in studying the qualities and composition of the air we breathe. If there was one substance in Nature concerning which the somewhat pert "scientist" of the generation that is now passing away might have claimed, apparently with reason, to know everything, it was air. We refer to the men of whom the late Professor Huxley was, not altogether fairly, taken to be the typical representative—men who lectured and wrote learned essays about the "laws of Nature," and "science," in which one might search vainly for any admission that everything was not known to the exponent. It was the fashion of those days to regard "air" as a popular expression for a mechanical mixture of the gases oxygen and nitrogen which occurred everywhere of a very regular composition. This air contained a small quantity of "impurities," the occurrence of which was rather resented as interfering with the simplicity of the true mixture. Curiously enough, a more modern science has busied itself less with the grand generalizations of the older knowledge than with the multiplicity of small discrepancies of detail which the most exact observation reveals in the majority of physical investigations. Whenever this science succeeded in getting a substance exactly 100 per cent. pure, or in determining a weight or a measurement precisely to the theory, it put the matter aside as settled and done with. Henceforward the substance was relegated to the quiet resting-place of the known thing. It ceased to be interesting. Wherever there was a margin to be marked "unaccounted for," there science settled down to track the secret to its lair. Impurities! There were no such things. The unknown, or the irregular but always present fractional components of a substance came to be regarded as its most interesting feature. What were they, and whence came they? How much of them could be found, here, there, or anywhere? So the frontier of the known has been pushed forward, with the immediate consequence of rendering men much less confident in their talk about the known laws of Nature than their predecessors. It is a good lesson, that needed teaching.

WATER AND SANITARY AFFAIRS.

THE evidence given by Mr. Littler, Q.C., before the Royal Commission on the Metropolitan Water Supply last week, in his capacity as Chairman of the Middlesex County Council, had the merit of being particularly interesting on account of the terse and vigorous manner in which the leading points were dealt with; the speaker appearing as a witness, but handling the subject with all the keenness of a parliamentary lawyer. In short, Mr. Littler was an able and a highly qualified witness; rendering public service by the vivid light in which he placed the component parts of the inquiry. He was in a position to represent the views not only of the County Council of Middlesex, but also of the several Local Authorities with whom the Council had conferred. The view entertained by all these parties was that the purchase of the water undertakings, whether by the London County Council or by any other authority, could not possibly do Middlesex any good, and might do the local interests a great amount of harm. The better plan was simply to maintain the *status quo*, and to "let well alone." Yet there was just one point on which Mr. Littler's evidence appears open to objection, as being too intensely local. It would almost seem as if, in his opinion, the Thames was the special property of Middlesex. Not content to urge that Middlesex should have its wants duly secured, he went on to draw a line specifying that London should take a certain quantity of water from the Thames, "and no more." The Middlesex Authorities contended that no greater quantity of water than was already legalized should be taken from the river, or from wells sunk in the county, except for the supply of Middlesex itself. The 185¾ million gallons of water per day which the Companies may extract from the Thames is not to be exceeded. But why not? A reason given is that Middlesex is higher up the river than London, and therefore has a superior right to the waters that come down from above. But there are other places higher up the stream than Middlesex; and if these are to claim all the water that exists in their area, how does Middlesex stand? Moreover, Middlesex itself is supplied in no small degree by the Metropolitan Water Companies, especially by the Grand Junction, New River, and West Middlesex Companies. Two-thirds of the population of the county are thus provided for. That Middlesex should lay an embargo on the Thames beyond its own real wants, is absurd, and proposes a monopoly of the very worst description. We observe that a concession is granted with respect to Surrey, which may also supply itself as it needs by drawing from the Thames. It would be strange were it otherwise.

We are sorry to dwell on this weak point in Mr. Littler's evidence, when so much is in full accordance with an enlightened public policy. He brings forth statistics which show that the acquisition of the water supply by municipal authorities has led in several cases to an increased charge on the consumer. There is no reason to suppose that London would escape a similar fate. As for a Trust, Mr. Littler believes that Middlesex would constitute such an infinitesimal minority in a body of that description, that its interests would never be properly cared for. If there is to be a purchaser at all, he prefers that it should be the State. Lord Llandaff fears that any such proposal would be very unpopular; but Mr. Littler has his own preference nevertheless, though he desires still further that his county should be allowed to remain undisturbed in respect to the Water Question. In any change he foresees increased costliness. At present, he says, the Companies in Middlesex are charging very low rates, and no interference is likely to be beneficial. Respecting the mode of effecting purchase, Mr. Littler hoped that Parliament would not sanction a special arbitration clause "to deprive people of their pro-"perty." But unless this were done, he was fearful that the price would be very large, and highly disadvantageous to Middlesex. This bears at once on the strong motive which influences the London County Council in seeking special terms in the purchase of the water undertakings. True economy demands that the Companies should be left in possession. To dislodge them involves a result either costly to the consumer or unfair to the Companies. Questioned as to the Staines scheme, we find Mr. Littler sharing some of the views expressed by Mr. Tendron respecting the financial burdens which it will bring on the Companies connected with it. But he feels no doubt as to the ability of the Companies to meet the increased charge resulting from the execution of this admirable project. The responsibility of Parliament with regard to the future of the London Water Supply is sagaciously pointed out, when Mr. Littler says that, but for the circumstance that Parliament has of late purposely given the Companies only such powers as were necessary to cover short periods, he had no doubt that by this time they would have made very large provision ahead. The timorous policy of Parliament has so far prejudiced the Metropolitan Water Supply. The idea that the undertakings may have to be purchased and transferred comes as a drag upon every scheme for permanent improvement.

The Chairman of the Southwark and Vauxhall Water Company was able to give a more than usually cheerful greeting to the shareholders in that undertaking at their half-yearly meeting last week. An increased dividend is always a source of satisfaction; and that which the Directors recommended on this occasion was higher than any the Company had enjoyed for some three or four years past. That this was due in some measure to the exercise of discretion, and was not merely the result of unmerited good fortune, appeared by the fact, to which the Accountant to the County Council had borne testimony before the Royal Commission, that in respect to the Southwark and Vauxhall Company the cost of management per million gallons was less than in the case of any of the other

Metropolitan Water Companies. The County Council may, if they please, say that the Company give too much for the money; the supply being more per service than occurs with five of the other Companies. But this is a fault which "leans to virtue's side," although the difference in the rate of expenditure is so great that the variance in the volume per service can have little to do with the comparative result. It is also well that the Company cannot be charged with swelling their dividends by stinting the supply. With a certain class of critics, a Water Company can never be in the right; and Sir Henry Knight signified that some things had been said in disparagement of their undertaking which would be thoroughly refuted at the proper time. Of course, much of an adverse character has been said before the Royal Commission, as also in the House of Commons, where the County Council strove to the uttermost, though in vain, to prevent the passing of the Bill which, by providing for an adequate supply of water, was primarily identified with the interests of the public. The Southwark and Vauxhall Company may now look with confidence for final success in the House of Lords.

Although not sufficiently encouraged by present circumstances to adopt the same jubilant tone as the Chairman of the Southwark and Vauxhall Company, Mr. F. Tendron gave a spirited and hopeful address from the chair at the meeting of Grand Junction shareholders last Wednesday. He had to speak of a dividend which for some years had remained at 1 per cent. below the level of former times. Yet it will be observed that even this reduced dividend is higher than that which is giving such satisfaction to the southern Company. Sir H. E. Knight sees that undertaking paying 6 per cent.; and he hopes for 6½. Mr. Tendron regrets that the Grand Junction shareholders only get 7½ per cent., whereas formerly they had 8½. But in the latter instance, as well as in the former, we seem to discern the laying of a broad and deep foundation on which no small measure of prosperity will be established in the future. The period is one of transition, and there is a distinct guarantee of coming success. Mr. Tendron feels the weight of growing burdens, especially in connection with the Staines scheme; and he looks upon the imposed sinking fund as "an abomination." But there is no need to meet trouble half way; and the increasing revenue will come to the rescue. There will be a heavy charge to bear, but an enlarged income to meet it, without the necessity of constructing fresh works. According to the assurance given by the Company's Engineering Director, Mr. Walter Hunter, when the Staines reservoir is completed they will have the command of a supply greater than any they are likely to require up to the year 1937, although the demand will be very largely increased. On this point Mr. Tendron discreetly observes that the Royal Commission will not regard so much the position of an individual Company as the requirements of London considered in the aggregate. At the same time, the aggregate is composed of the individual elements; and Mr. Tendron's meaning is that the Royal Commission will require to see provision made for every district in the Metropolis. Hence his earnest wish that the Companies should give evidence before the Commission, showing that they are quite willing, on certain terms, to effect a junction between all their mains, so that every part shall be duly supplied; the Companies holding themselves jointly and severally responsible that the wants of London in respect to the supply of water shall be met, whether by reservoirs in the valley of the Thames, "or by bringing water from a distant source." This is certainly going to the root of the matter; and there is the further view that such a union of their resources would enable the Companies to raise capital on easier terms than at present. But the contingency of fetching water from "a distant source" is somewhat startling. Mr. Tendron rates the cost of this at £16,000,000; and he proposes a particular plan for defraying the current interest. Altogether, Mr. Tendron has given a very weighty and important speech, going far beyond the ordinary range of argument on the subject in hand. He gave the County Council a shrewd rejoinder, by observing that if the reservoir capacity was to be so greatly enlarged, and there was to be such an immense supply of water for London as to provide for a population of 12 or 13 millions by 1931 or 1937, how was it that nothing was heard of any great scheme of sewerage to carry off all this water? The County Council are very willing to lay a load on the Water Companies, but they seem to lose sight of their own responsibilities.

INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE GENERAL MEETING,

HELD AT THE

ROYAL UNITED SERVICE INSTITUTION,

WHITEHALL, S.W.,

JUNE 14TH AND 15TH, 1898.

Mr. G. E. STEVENSON, M.Inst.C.E., President.

REVIEW OF PROCEEDINGS.

THE members of the Institution of Gas Engineers foregathered on Tuesday morning in respectable force at the Royal United Service Institution, Whitehall, under climatic conditions calculated to put them, as business men, in the highest spirits. Of all the cool and gloomy days of this backward season, Tuesday was one of the darkest and dreariest outside—a circumstance which was not without a redeeming side from the point of view of those who knew that there is comfort and solace for such a state of things in well-stocked gasholders.

Mr. Corbet Woodall took the chair at the commencement of the proceedings, only to give place to his successor in office, Mr. G. E. Stevenson, after the brief preliminary business had been duly disposed of. Before leaving the platform, however, the retiring President was made the recipient of a well-deserved vote of thanks, moved by Mr. George Livesey and seconded by Mr. Thomas May, for his conduct as President of the Institution during the past year. It is unnecessary here to dilate upon the quality and extent of the services rendered to the Institution by Mr. Woodall during his term of office. It is enough to say that, in thus aiding the Institution, Mr. Woodall has earned the reward of an enhancement of his already great reputation both as a man of affairs and of personal amiability and liberality not to be surpassed. In acknowledging the vote, Mr. Woodall deftly passed on a due share of the compliment to the Continental Engineers with whom it is one of his merits to have placed the Institution into such intimate relations as no other intermediary could have compassed.

After Mr. Woodall had thus taken a formal and graceful farewell of the chair of the Institution, the meeting settled down to hear Mr. Stevenson's address. The text of it was published in last week's "JOURNAL." It was characterized throughout by marked restraint. Not in regard to any one division of his matter did the President really "let himself go;" so that the impression created by his observations was generally that he could have said more, had he been so minded.

The plan of the address was that of a critical commentary on the actual circumstances and recent progress of the gas industry of the United Kingdom, from the standpoint of an expert observer who has kept himself posted in these respects, but is not carried away by the enthusiasm of the Progressivist. Indeed, early in the address there occurs a passage which might be taken as a confession by the President that he has definitely entered the category of the "grave and reverend" seniors of the profession, from whom not much more in the way of novel endeavour is to be expected. He says "let us look to the younger mem-"bers of the Institution to keep alive the originality of our "proceedings, and give them every possible encourage-"ment to impart their views and describe their experi-"ments." And he goes on to declare that the new hands are those most fitted, "and most free," to develop the new ideas which are the nervous energy of all industries. There is a somewhat melancholy air about these expressions which irresistibly recalls the fact that the Mr. Stevenson, who was once known as an apostle of new technical methods, is now, as the Chief Engineer of the Manchester Corporation Gas Undertaking, subject to the moderating, not to say the benumbing, influence of that spirit of Municipalism in manufacturing industry which prefers old ways to new ones. Yet it is not to be supposed that even Manchester is inhospitable to all new things in gas making; evidence to the contrary being afforded in other parts of the address.

It is easy to be understood, however, that the Chief

Engineer of a municipal gas undertaking, compelled by the necessities of his position to play the critic oftener than the creator, may look with a touch of envy at the younger men who, with greater liberty and less responsibility, are able to dream dreams of improvement, and to do something towards realizing them. It is quite true a new technic usually goes better in new hands than in old ones; but it does not often happen that the young men have the opportunity of carrying out what they have a mind to try. It is rather the older men—the occupants of positions of power, and of consequent responsibility—who have the say as to what schemes shall or shall not be tried; so that the honours of leading on a great industry in the path of safe and honoured progress are pretty fairly divided between experience and originality. Of course, it is only human nature that men belonging to the complementary forces of industry should entertain the wish to change places with one another. The young draughtsman or chemical assistant looks up to his Chief as to a man who has achieved the great object which he himself has in life; while the Chief in his turn is fascinated by the vision of all that the future may conceivably have in store for those who will go on where he must leave off.

But these be vain musings. What is the thing that lies nearest to hand, to be done first by him who would leave the whole world, and his own corner of it, a little better than he found it? There is the question of labour in gas manufacture, its remuneration, and the improvement of its applications. The President hardly handled this topic with a strong grip. There was a passage surrounding the observation that the workman is too often regarded as being "in some sort of sense a chattel of the employer," which might have been treated to greater advantage. The President might have stated how the Manchester Corporation are working out the labour problem, or have discussed the general question of the way in which the municipalization of gas undertakings has tended to affect the circumstances of the workpeople who are engaged thereon. Suppose, for example, the gas workers of a city which—not to be invidious—shall not be Manchester, or Liverpool, or Sheffield, or Birmingham, were to exercise a right of voting for company or municipal control, how would they be likely to cast their vote; and why?

Both gas companies and municipalities owning gas undertakings are leading on a revolution in the conditions of labour in their works which cannot fail of having grave economical consequences. The work of gas-making is fast slipping out of the hands that have hitherto monopolized it. The days of the "man with the shovel" are numbered, so far as his supremacy is in question. Soon he will not be able to assemble "in his thousands" to say whether a town shall or shall not be put in darkness. The agricultural labourer, the brickmaker, and the navvy are losing their winter's turn at gas stoking. In their stead the dapper mechanic is being installed and rendered competent to do the same service to the community without turning a hair during his spell. It could have been wished that the President had discussed the responsibility of our municipalities for keeping up, by the operation of well-advised educational methods, a sufficient supply of the right kind of gas workers for the future. This is a matter that is certain to force itself upon the public mind sooner or later; and it is the duty of the expert witness to forecast the way by which what will otherwise be a difficulty may be avoided.

Capital and mechanical ingenuity are making the modern retort-house no place for the old style of gas worker, who deemed himself a skilled and indispensable man because he could handle a shovel deftly or run a scoop smartly. Twenty years ago, the "stage" was unknown out of the largest London gas-works. Nowadays, the gas engineer who should propose to repeat the plain retort-house construction of that era would confess himself a reactionary; and only the Gas Workers' Union would pat him on the back, as a preliminary to mounting upon his shoulders. Consequently, the President had to go back to Mr. H. E. Jones's paper of 1875 to find the standard of cost of the earlier type of retort-house. He was able to prove from this datum, without difficulty, that the more costly modern type of retort-house justifies itself. From the retort-house to the retorts is a natural step. The President certainly criticized the inclined retort system intelligently, if not profoundly. The weakest part of this section of the address was in the comparison of the relative advantages of inclined retorts and horizontal retorts with mechanical stoking. He gave it as his opinion that in such a comparison the inclined retort system possesses "certain very definite advantages;" and he then confessed that it is not very easy to see at first wherein this advantage consists. But if the advantages are so very "definite," how comes it that they are not to be perceived at a glance? The President's conclusion in this regard is that it is in the working of inclined retorts by gravitation that their chief merit is to be found. This is a little vague. Is it not the fact that one of the chief recommendations of the inclined retort system lies in its independence of the scale of carbonizing operations? Mr. Stevenson commends the system "more especially for works the magnitude of which is not sufficient for the full development of power-stoking machinery." But it is very generally understood that one of the characteristics of every system of mechanical stoking is the number of mouthpieces that every machine is able to command. Hence, in lighting-up or letting-down carbonizing plant, the full economy is only realizable when the units of gas-producing power so treated correspond with the working force of the machine. In some works, the ideal aimed at is to keep the same number of hand stokers at work all the year round, supplementing them during the busy season by machinery. As against this must be set the greater cost of machines which are only worked for part of the year. None of these considerations applies to the inclined retort principle, which works as well with a single setting as with a hundred.

The President gives a detailed analysis of the cost of wear and tear of plant and machinery prevailing at the Rochdale Road station of the Manchester gas undertaking, which amounts in round numbers to 1s. 9d. per ton; and he follows this up by the most definite statement yet published, within our knowledge, of the commercial advantage of the regenerative system of retort firing. He declares that the introduction of the system is to be credited with having increased the quantity of coke sold out of the works from 6·67 cwt. per ton of coal carbonized in 1891, to 9·50 cwt. per ton at the present time. This is the highest claim of the kind ever seriously advanced. The presidential criticism of the technical value of carburetted water-gas plant is just. He lays stress upon the advantage of making a 25-candle power carburetted water gas, for enriching purposes, as compared with a lower quality of the same product; and he shows that, after all, the economy of the manufacture rests upon a small basis, in the price of the oil. This consideration alone would prevent British gas managers from depending over much upon carburetted water gas. It is worth knowing, on Mr. Stevenson's authority, that the capital cost of carburetted water-gas plant, bulk for bulk of productive capacity, is two-thirds that of coal-gas plant.

Other points of gas manufacture are discussed; and the address concludes with a suggestive commentary on the actual and possible economies of gas distribution and utilization for various purposes. We welcome the presidential utterances in this regard as a testimony of the awakening of gas engineers to cognizance of the fact that gas distribution has not been improved correspondingly with other points of gas management. It is high time that this branch of the industry were taken in hand in a new spirit, with the desire of bringing the practice into line with the modern work of electricians and others who share the streets with the mains and services of the gas undertaking. The circumstance that there is no "royal road" to success in this department of the industry—all real improvement being a matter of painful attention to details—should only instigate gas officials to greater efforts to place their work beyond reproach. The time has long passed when the gas and water mains, each on its own side of the road, shared the subsoil of the streets between them. The time may come when gas-mains will be in danger of being crowded out of the streets altogether, to make room for conduits and cables and subterranean works of another kind, with newer claims upon the amiable consideration of the highway authorities. Then the testimony that gas distribution has or has not been kept abreast of the requirements of the age, will weigh with those who have the disposal of such matters. Gas mains and services have a statutory right to the streets; but they must be laid and maintained in accordance with the best known methods, in order to escape indictment.

The President had not much to say concerning residuals;

and what he did advance was not very hopeful. The fact of such a serious matter being allowed to pass with so little comment is significant of the nature of the case.

The address was very well received; and the customary acknowledgments were made on behalf of the Institution by Mr. G. C. Trewby and Mr. Charles Hunt.

The next proceeding was the formal consideration of the reports of the Institution Committee on Standards of Light and the Temperature of Gas Measurement. In regard to the latter subject, Mr. Hunt, a member of the Sub-Committee, supplemented the returns by detailed information of the kind suggested as desirable in one of our "Editorial "Notes" on the 7th inst. The discussion that followed turned wholly upon the question of the datum of temperature correction, with the object of establishing a trustworthy relation between the bulk of gas measured by the consumers' meters and that sent out from the works. No definite resolution was arrived at in this regard; but most of the speakers seemed to incline towards acceptance of the suggestion that, if there is to be correction for temperature at all, it should be based upon the observed facts applying to every individual case.

The first paper taken—very appropriately—was that by Mr. Fletcher W. Stevenson, on "A High-Pressure System of Distribution." The importance of this subject is great and growing, seeing the increasing difficulty met with by gas engineers in finding room for large low-pressure mains in the crowded subsoil of the thoroughfares of our great towns. The paper brought out an interesting disclosure of new practice recently adopted in the South Metropolitan district; and the whole of the discussion was of a peculiarly pointed character, so that it alone may be said to have thoroughly justified the meeting.

The afternoon sitting was devoted to the presentment of the latest practice in inclined retort setting and working, by Mr. E. Drory and Mr. F. D. Marshall respectively. A degree of piquancy was imparted to the matter by the fact that both authors dealt with Continental examples, which thus fell to be criticized by English technicians. The chief characteristic of the Continental form of inclined retort is shortness—a feature upon which Mr. Marshall in particular laid the greatest stress. The discussion was instinct with actuality. The slipping down of the coal charge after the closing of the lids was made a prominent point in the debate. But it must be stated that a strong defence of mechanical stoking for horizontal retorts was delivered with much emphasis by Mr. Carpenter; and Mr. Marshall's general scheme of coal handling was sharply criticized by Mr. Hunt.

Business on Wednesday began with what was supposed to be the reading of Mr. Vernon Harcourt's paper on his new ten-candle pentane standard. But the temptation to interpolate further detailed explanations proved too great for the distinguished author; and consequently his performance extended very far beyond the strict presentment of the paper. It is a curious circumstance that the professorial mind often shows itself predisposed to this fault, which is both an offence against the audience and a weakness in the author. In the present instance, a paper which might have been read in twenty minutes was expanded to an hour's talk which could not be intelligently followed, and of which necessarily no record remains. Mr. Pryce's paper was next taken; and the whole of the morning was occupied with the discussion of the considerations arising from these two communications. The occasion was rendered memorable by the appearance for the first time before a gas engineers' conference of Professor C. Vernon Boys, the new London Gas Referee. The tenour of the discussion went to demonstrate once more the conventional character of gas photometry, and the lack of agreement between the conditions necessary to be observed in the practice of this statutory art and the use of gas for ordinary purposes. During the greater part of the morning, all three of the Gas Referees—the veteran Dr. Pole, Professor Vernon Harcourt, and Professor Boys—were present, and thus testified in the most practical fashion to the importance of the occasion, and the value of the opportunity for discussing the subject provided by the meeting.

For Wednesday afternoon the programme was varied; beginning with a paper on "A New Departure in Coal Carbonizing," by Messrs. S. and T. Glover. When it is understood that this communication raised the vexed question of naphthalene, no more is needed to indicate that the discussion was of a decidedly pointed, not to say disputatious, character. This occupied so much time, that Mr. Harman's paper on "Washers and Scrubbers" had to be taken as read; discussion on its leading points being invited. The author, however, supplemented his paper with a statement briefly explaining his views of the subject. But this had also to be hurried over, in order that the sitting might be concluded at a reasonable hour. The formal votes of thanks were then accorded; and the meeting was made special for the purpose of effecting the constitutional reform of the Institution of which notice had been given. It was unanimously agreed that the interests of the Institution require the appointment of an Honorary Secretary; but the Council did not press their other proposal in regard to the investment of the spare funds in gas companies' ordinary stocks.

The Institution dinner on Tuesday night was a great success, socially. The excursion on Thursday—when the members of the Dutch Gas Managers' Association, headed by their President, Mr. Van der Horst, made their first appearance as guests of the Institution—was carried through with great brilliancy, to the complete satisfaction of all concerned. Praise must be accorded to the Council for the perfection of all their arrangements, which the generosity of the subscribers to the special entertainment fund enabled them to make on a very liberal scale. Fine weather favoured the river trip, which was extended to below Purfleet in order to give time for the discussion of the excellent luncheon provided on the steamer. A brief halt, without landing, was made off the Beckton jetty, to permit inspection of the machinery for discharging coals; and at East Greenwich the party had more than an hour for walking through the works. Mr. Frank Livesey had thoughtfully provided a description and plan of this station, in English and Dutch, for the use of the visitors. A truly sumptuous banquet and a display of fireworks at the Crystal Palace brought to a conclusion one of the most business-like and enjoyable meetings the Institution has had during its useful existence.

REPORT OF PROCEEDINGS.

The General Meeting of the Institution was held last Tuesday and Wednesday, at the Royal United Service Institution, Whitehall.

Mr. CORBET WOODALL, the retiring President, occupied the chair at the commencement of the proceedings.

ANNUAL REPORT AND ACCOUNTS.

The report of the Council and the statement of accounts were taken as read; and, on the motion of the CHAIRMAN, were unanimously adopted. The report was as follows:—

The Council have the pleasure to record, in their eighth annual report, that the increase in membership during the last twelve months has been the largest since the formation of the Institution. It will also be seen by the balance-sheet that the Institution's financial position is in a satisfactory and improving condition. Its usefulness is not less progressive; and the record contained in the last volume of "Transactions" may fairly be considered conclusive of the position it occupies in relation to the profession it represents.

The spring and autumn visits have now attained an important place in the work of the Institution, alike in broadening the knowledge of contemporary gas engineering practice, and in bringing members together for mutual intercourse. The autumn visit of 1897, inaugurated at Amsterdam, and extended through some of the chief cities of Holland and Belgium, was unique in its character; and the Council desire to take this opportunity of recording their appreciation of the great hospitality and kindness extended to the members on every hand. The spring meeting has this year been arranged a month later than usual, in order to meet the convenience of the Dutch Institution of Gas Engineers, who will visit England in June. The Council have spared no effort to make their reception worthy of the example set in Holland; and they ask the co-operation of every member in promoting a hearty reciprocity of good-fellowship and goodwill.

The first report of the Committee appointed to consider the question of standards of light and correction for gas temperature has been circulated among the members, and will be found a valuable and comprehensive *résumé* of a subject so vitally important to gas engineers as that of a reliable photometric standard. The second report deals with the question of gas temperatures, and will be found of great practical value.

Seven admission applications from students were made last year. Students of the Institution have privileges which should be a great boon to the younger members of the profession; and

the Council again urge members to assist their endeavour to obtain a large accession of numbers to this class.

The Council record with deep regret the death of Mr. John Methven, of Beckton, and of Mr. Frank Mead, of Sutton. Mr. Methven was an original member and a Past-President of the Institution, to the usefulness of which he greatly contributed.

The accounts to Dec. 31, 1897, have been duly audited. The Council have suggested certain modifications in the Articles of Association; and for the purpose of considering the same a Special Meeting will be held at the close of the Annual General Meeting.

Additions to the Roll.

The following gentlemen were reported by the Scrutineers to have been unanimously elected :—

MEMBERS.

Berridge, T., Gas-Works, Leamington Spa.
Beynon, R., Gas-Works, Torquay.
Crossley, T., Gas-Works, Guernsey.
Drory, J., Gas-Works, Aix-la-Chapelle.
Foulger, G. F. L., Gaslight and Coke Company, London.
Helps, G., Gas-Works, Nuneaton.
Jones, H. H., Gas-Works, Wandsworth.
Kitt, Alfred, Westminster.

ASSOCIATES.

Arnold, F., Guernsey.
Ashworth, J. D., Portsmouth.
Hunt, P. C. Holmes, Windsor Street, Birmingham.

The Chairman said he regretted that an application from Mr. Irminger, one of the Engineers to the Municipality of Copenhagen, arrived too late to be issued with the ballot forms; but he had no doubt he would be elected on the next occasion. He then introduced his successor, Mr. George E. Stevenson, M.Inst.C.E., saying he felt sure that, with the programme before them, and with Mr. Stevenson as President, the meeting would be a very useful, and he hoped a memorable one.

Thanks to the Past President.

Mr. Stevenson having taken the chair,

Mr. George Livesey said they had one duty to perform before the new President entered upon his duties; and he moved—"That the best thanks of the meeting be given to Mr. Woodall, the retiring President, for his services to the Institution during the past year." There was no need to say anything in support of the resolution, for the record of the past twelve months was quite sufficient to recommend it. They had had many able Presidents; but none had exceeded Mr. Woodall in the work he had done for the benefit of the Institution. It might be said that he had extended the work and made it international, by introducing them to their friends on the Continent, and also by inducing those friends to come to England. He had known Mr. Woodall for many years, and was glad to see that he had attained the highest position in gas engineering ever occupied by any man in the profession.

Mr. T. May (Richmond) seconded the motion, which was carried by acclamation.

Mr. Woodall, in reply, said he was much obliged for the vote. His year of office had been a very pleasant one, because there had been displayed throughout such a cordial and hearty feeling among all the members, both at the meetings and elsewhere, that it had brought to him many new friends, as well as bound more closely many ties which had lasted for a long time. He felt very strongly the usefulness of the Institution, not only to its members, but also to gas companies and corporations and to the industry as a whole. It had a very large and positive value, which he hoped would be demonstrated more and more as time went on. Last year they had a special feature in the fact that they had extended their visits to works outside their own country; and apart from the very great pleasure derived from this visit, it was also of considerable use in showing them that they had no monopoly of knowledge with regard to even their own industry, and that there were some things to be seen in the works of their neighbours which were well worth consideration, and even imitation. It was of great encouragement to him to find among their foreign friends so much readiness to communicate information, not merely to their engineering brethren, but to others. It was very gratifying to see how cordially the works of their friends were thrown open to them; and he was glad to think that during the present meeting there would be ample opportunities of reciprocating this courtesy. Mr. Livesey was in error in saying that they had persuaded their friends from Holland to come over, as their arrangements had already been made for a visit to London in connection with their annual meeting; but the Institution gladly took the opportunity to try and make their visit as pleasant as possible.

President's Address.

The President then read his Inaugural Address, which was given in the "Journal" last week (pp. 1368-72).

Mr. G. C. Trewby proposed a vote of thanks to the President for his address. Like most addresses on such occasions, it bristled with contentious matters; and with some of the opinions expressed many might agree, while others would possibly disagree. It was not in order to discuss these questions, nor would time allow of doing so; but he was quite sure the members would all agree in according the President a hearty vote of thanks for the very able manner in which he had brought together his statistics, and for the interesting matter contained in his address.

Mr. Charles Hunt (Birmingham) said he had much pleasure in seconding the motion. The chief point which struck him about the address was its practical character. It was an admirable *résumé* of work done; and he was sure it would be read with interest and profit.

The motion having been carried unanimously,

The President, in responding, said it was not his intention to introduce any contentious matter into his address; and if he had done so it was quite unconsciously. He had given in some instances his own experience, and in others his opinions based on experience; but he did not mean that these opinions were, in any sense whatever, to be taken as law.

Reports of the Committee on Standards of Light and Temperature of Gas Measurement.

[See "Journal," Jan. 18, p. 124; June 7, p. 1311.]

The President said the next business was to deal with the reports of the Special Sub-Committee on Standards of Light and Temperature of Gas Measurement. They had been printed and circulated among the members; and he thought the best way would be for him to move that they be approved and adopted.

Mr. W. Foulis (Glasgow) and one or two other members suggested that the reports should be discussed simply, without any motion for their adoption.

The President said there would be no objection to this.

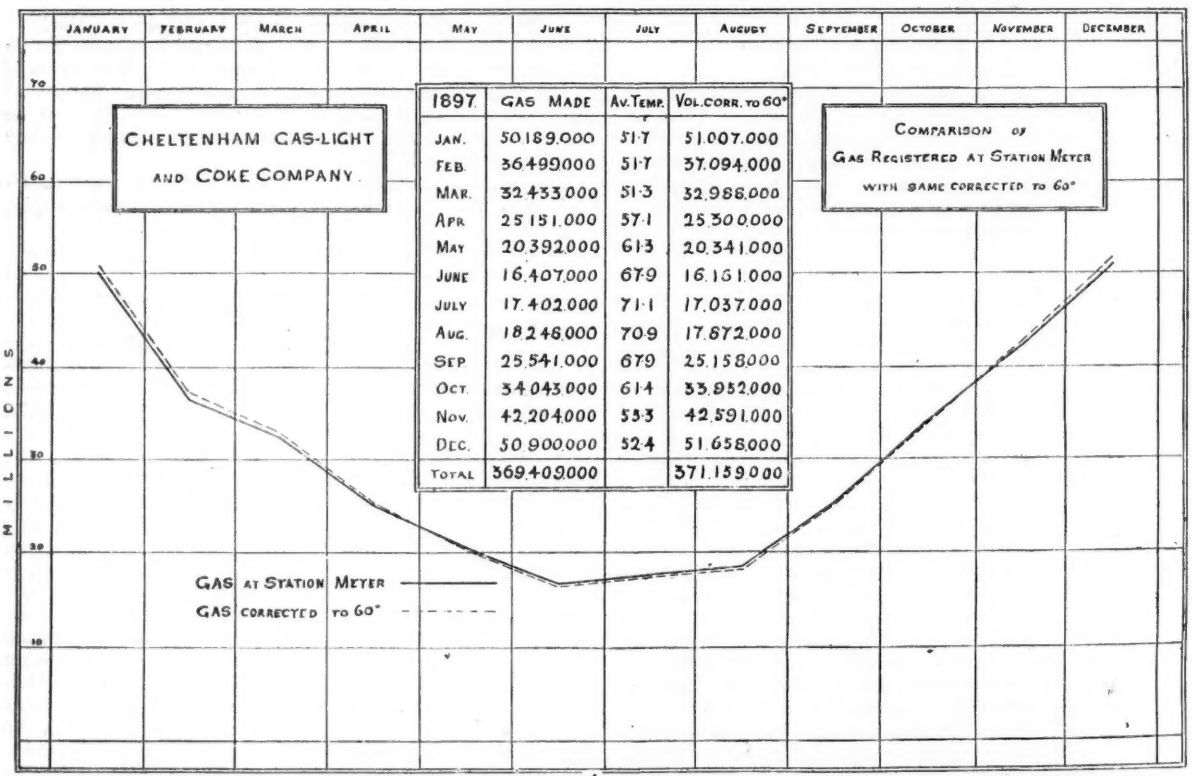
Mr. Hunt said, with regard to the first report, he wished to emphasize two facts. The first was that, in the whole of the experiments made with the Dibdin burners the method of substitution was employed, and thus any source of error which might arise from reflection or imperfect eyesight was eliminated. In the second place, two principal difficulties were met with in the experiments—one that the burners were not interchangeable—that was to say, hardly any two burners that were tested were alike—and the other, that the chimney was likely to be a principal source of error. The first objection was probably caused partly by imperfect manufacture and partly by the chimney. The second, of course, was attributable to the chimney alone. But, both of these defects having been acknowledged, it was probably hardly worth while to discuss them; nor was it desirable to anticipate anything which might be said on Mr. Harcourt's paper, to which they all looked forward with much interest. He would therefore pass on to the second report, relating to the temperature at which the gas was measured. This arose out of a paper read by Mr. George Livesey two years ago, in which he impugned the desirability of the usual practice of correcting to a temperature of 60° Fahr. the volume of gas as measured at the works. At that time he (Mr. Hunt) was one of those who doubted the desirability of any change; and he was fortified in this doubt by the series of observations made in Birmingham with regard to one meter only at one particular part of the district. The temperature at this meter appeared to agree fairly well with that of 60° to which the measurement at the works was corrected. The result of the experiments, however, showed clearly the undesirability of founding any opinion on a single set of observations; for, taking the average of the experiments of the four gentlemen who made them, it was proved that the temperature of the gas followed that of the air—not exactly, because, no doubt, the position of the consumers

meters varied. There was, however, a distinct relation between the temperature at which the gas was measured and the atmospheric temperature. In his own case, the difference between the correction to 60° and the volume which would have been recorded had the temperature at the consumers' meters been taken, amounted to nearly 2½ per cent.—that was to say, the unaccounted-for gas, instead of being recorded at something less than 6 per cent., would have been about 3½. This was the actual loss due to leakage and to waste of all kinds; and it proved, he thought, the great importance of the matter. It was in some cases in the hands of the gas manager himself. It depended very much on the relative position of the station meter and the purifiers whether or not the temperature as measured approximated to that of the air. He suggested this in the discussion which took place two years ago; but he was at once met by the objection that, especially in large works, it was exceedingly difficult to obtain anything like sufficient condensation or cooling between the purifiers and the station meter to ensure a temperature approximating to that of the air. He quite admitted the force of the objection; and therefore the suggestion in the report was that, instead of the correction being made to 60°, it should be made weekly according to the average observed temperature of the atmosphere. This would not get an exact record of the alteration due to the temperature, but it would be near enough for all practical purposes. The idea appeared to prevail that, if the temperature were taken when the consumption was least, it would not correctly record the actual temperature at which the gas was measured. Now, one of the sets of observations made in Birmingham was made by himself at his own house. For some considerable time he took the temperature during the morning, when the consumption was least, and at night, when it was supposed to be greatest; and he found little or no difference between the two. Any difference there was might have been due to some slight change in the atmospheric temperature. After a few months, therefore, he gave up making two observations, and only took the temperature in the evening, when the consumption was greatest. He did not know whether it would be thought desirable to take any collective action in this matter; but, if so, he thought it should be in the form of a recommendation that the usual correction to 60° be abandoned, and in place thereof a correction be made to the average temperature of the atmosphere.

Mr. George Livesey suggested that it should be a little above that.

Mr. Hunt said perhaps it might be a few degrees higher, to correct any little difference there might be between the temperature at the consumers' meters and that of the air. This was not always necessary; but it was in some cases.

Mr. R. O. Paterson (Cheltenham) said Mr. Hunt had very fairly laid the facts before the meeting; but he should just like to utter a word of caution on this matter. He was not sure that they were prepared to go the length of making a representation of so definite a character as the alteration of the recognized method of estimating the volume of gas at a fixed temperature, because they might get such a number of standards all over the country that it would be very difficult in future to make comparisons. The observations which had been carried out showed very clearly that the correction to 60° was a decided method of obtaining a high leakage account; because the measurement of the gas at the consumers' meters undoubtedly showed it to be considerably lower than this. On the other hand, many of them had never corrected the gas measurement at the station meter to the 60°. He had never done so, because he always thought that the average of twelve months would bring him out pretty nearly level; and he preferred leaving it. He had had a diagram of the temperatures made, which he would hand to the President.



1897.	GAS MADE	AV. TEMP.	VOL. CORR. TO 60°
JAN.	50189.000	51·7	51.007.000
FEB.	36499.000	51·7	37.094.000
MAR.	32433.000	51·3	32.986.000
APR.	25151.000	57·1	25.300.000
MAY	20392.000	61·3	20.341.000
JUNE	16.407.000	67·9	16.161.000
JULY	17.402.000	71·1	17.037.000
AUG.	18246.000	70·9	17.872.000
SEP	25.541.000	67·9	25.158.000
OCT.	34.043.000	61·4	33.952.000
NOV.	42.204.000	53·3	42.591.000
DEC.	50.900.000	52·4	51.658.000
TOTAL	369.409.000		371.159.000

He found by it that if he had corrected every month by the average temperature, he would only have added 0·5 per cent., or rather less, to the volume of the gas. If they were going to propose correcting to 55° or 50°, he feared the comparisons over the country would be somewhat confused. Another point that arose in his experiments was that some care should be exercised in deciding at what point the gas should be measured in the station meter. He found that the temperature at the inlet was considerably different from that at the outlet. The water which was constantly trickling into the station meter from an overhead tank was of the usual temperature; and, of course, it was always below 60°. He had taken the mean of these, but was not quite sure that this was right. Perhaps greater care should be exercised in the warming of the meter, or of the water that entered it, so as to maintain an even temperature. The fact remained that the gas at the consumers' meters was undoubtedly considerably below 60°; and he thought the report of the Committee, in demonstrating this, would be useful.

Mr. T. S. Lacey (Pimlico) remarked that there was something more to be said with regard to the temperature of the gas as it went through the station meter. If the gas passing through a large meter was of very much higher temperature than that of the water, it would be found that, though there might be a difference of 10° or 12° as it entered,

when it left it would approximate to the temperature of the water within one or two degrees. It very rapidly assumed the temperature of the water, and this would be far nearer the temperature of the gas than either the mean or the inlet. If the average of the two were taken, in many cases it did not represent the temperature of the gas in the drum of the meter at the time of its being measured. This was rather important, if they wished to be accurate within 1 or 2 per cent. It was well known that, in the case of testing meters, the temperature of the water was invariably taken as the temperature of the gas. The object of taking 60° as the temperature was in order that some standard should be adopted; and this was the temperature usually adopted in England as the standard for water and other purposes, in comparisons of specific gravity, and so on. It was convenient; and certainly it would be absurd to manufacture gas and measure it without fixing the temperature of measurement. In winter, it would be measured at 40° or less, and in summer at perhaps 90°; and really the important question of how much gas they were getting out of a ton of coal would be perfectly absurd, unless some standard temperature were assumed. The object of fixing the temperature was simply to know what they were doing. The question of unaccounted-for gas or leakage was another matter altogether. If it were necessary to ascertain this, surely it was possible to make experiments and ascertain at what temperature the gas was consumed generally; and having found it, they could form some idea as to the relation between the figure and the volume turned out at the works. If the leakage was desired to be ascertained, this could be done separately, without varying the make of gas. If they said they made 10,000 cubic feet of gas, assuming it to be at a temperature of 60°, that was something definite; but if it could be at any temperature, it was hardly a scientific or rational system. The leakage was not necessarily the difference between the gas as measured at 60° at the works, and as measured at consumers' meters. Everybody who knew anything about gas making, knew this; and he did not see why they should alter their plans to meet the prejudice of people who knew nothing about the subject, and thought unaccounted-for gas was all due to leakage.

Mr. GEORGE LIVESEY said the reason for altering the plan was to avoid a correction which was absolutely incorrect. He found, in his own Company, correcting to 60° landed them in this difficulty: It showed them that they were producing more gas than they really were making; and their desire was to have something like accuracy. He was pleased to find that the result of the inquiry had put them in the way of getting some reasonable idea of what the unaccounted-for gas was. It was necessary to know continuously, from time to time, what this amount was. It did not do to make only occasional experiments, but quarter by quarter, half year by half year, or from year to year. The only way to do this was to correct the gas as measured at the station meter to something as near as they could to the temperature at which it was measured at the consumer's meter. In the South Metropolitan Company, they found it was better for the purpose of sulphur purification to get the gas tolerably warm in the purifiers. From thence it went to the station meter; and being measured in the ordinary way, it came out at too large a volume. The make per ton came out higher than they knew it could be; and therefore they had to reduce it as best they could. Now that they had these authoritative data, there would be no excuse for acting empirically in the matter; but he thought they should adopt the system of correcting the gas week by week to about 5° above the temperature of the atmosphere. This, he believed, would give them pretty nearly the quantity made as measured at the consumer's meter.

Mr. T. MAY (Richmond) thought that the information in the reports was very valuable; but there was a good deal of difference of opinion as to what should be done. He would suggest that the Committee, having heard the opinions of the members so far, should consider the subject again, and bring forward some recommendation according to which the gas all over the country could be corrected. They would then have some reliable means of comparing the results as to leakage generally.

The PRESIDENT said if no one else had any remarks to make, they would pass on to the reading of papers; but he thought they must recognize the labour and pains which the members of the Committee had taken in making these observations and drawing up the diagrams, which represented a considerable amount of work. Further than this he did not see that they could go at present. With regard to the question upon what lines the corrections should be made, any work of the kind which should form the basis of a system of correction would have to be of a very much more extensive character. The instances would be required to be more numerous; and, in fact, it seemed to him that the engineer of every undertaking almost should do this work for himself in his district—making his own diagrams, and working out from them the mean temperature (in each week or month of the year) to which the gas should be corrected. After all, there was no real object in measuring all the gas made in the United Kingdon at exactly the same temperature. The great thing was to get something to harmonize with the sales of gas. This was the important requirement. The records of the station meter were not the figures that returned any revenue to a company; it was the sale. Therefore, what was wanted was such a system or diagram of temperatures as would cause the make of gas to correspond to the sales, without, of course, cooking it in any way. He moved that the reports be accepted and printed with the proceedings of the meeting, and that the thanks of the Institution be given to the Committee for the pains they had taken in the preparation of the reports.

Mr. S. GLOVER (St. Helens) seconded the motion; and it was carried unanimously.

READING OF PAPERS.

The reading of papers was then commenced. They were taken in the following order :—

Tuesday.—(1) "High-Pressure System of Distribution." By FLETCHER W. STEVENSON. (2) "On Inclined Retorts." By E. DRORY. (3) "A Modern Gas-Works." By F. D. MARSHALL.

Wednesday.—(4) "The Pentane Ten-Candle Standard Lamp." By Professor A. VERNON HARCOURT. (5) "A Two-Candle Standard." By E. LLEWELLYN PRYCE. (6) "A New Departure in Carbonizing, having for its Objects the Prevention of Naphthalene Troubles and the Providing of Cheap Enrichment." By S. GLOVER and T. GLOVER. (7) "Washers and Scrubbers." By E. A. HARMAN.

The papers read on the first day, with a report of the discussions thereon, will be found in another part of the "JOURNAL." The remainder will be given next week.

At the close of the discussions on Wednesday afternoon, the general business was resumed.

APPOINTMENT OF SCRUTINEERS.

The PRESIDENT said they had now concluded the technical business of the meeting; but there still remained the formal business, the first item of which was the appointment of Scrutineers. Mr. Tysoe now desired to retire; and he would therefore move that Messrs. A. E. Broadberry, T. S. Lacey (two of the present Scrutineers), and Mr. W. E. Price be Scrutineers for the ensuing year.

Mr. BOTLEY seconded the motion; and it was at once carried.

VOTES OF THANKS.

The PRESIDENT then proposed a vote of thanks to the authors of papers, saying he had been extremely gratified at the highly interesting character of the papers and discussions on the present occasion.

Mr. HUNT, in seconding the motion, said it must be a great satisfaction to all the members to know that the quality of the papers had been so fully maintained, particularly as they had come to a large extent from the young members of the Institution, to whom, of course, they had to look for papers in the future.

The motion was carried by acclamation, and briefly acknowledged by Mr. MARSHALL.

The PRESIDENT next proposed a vote of thanks to Mr. Magnus Ohren, the Honorary Auditor; and it was carried unanimously.

Mr. HOLGATE proposed a vote of thanks to the Council, for their work during the past year—a year which would, he remarked, be memorable as the one in which the influence of the Institution had been extended, and the goodwill of the members so fully reciprocated by their brethren on the Continent.

Mr. HARMAN, in seconding the motion, said the heartiness with which it would be accepted would no doubt be

enhanced at the close of the following day, the arrangements for which afforded abundant evidence of the care and thought given by the Council to the best interests of the Institution.

The motion having been carried unanimously,

Mr. R. O. PATERSON, as a retiring member of the Council, responded. He said there was always a good deal of anxiety attaching to the Council as the time for the annual meeting approached; and it was a great satisfaction to find that it had proved so successful. He would take the opportunity of reminding members of the important duty of giving an early intimation of their intention to read papers, which would be a relief to the Council.

Mr. FOULIS moved a vote of thanks to the President.

Mr. HELPS, in seconding the motion, said Mr. Stevenson might congratulate himself, he thought, on having presided over the most businesslike meeting in the history of the Institution.

The PRESIDENT, in responding, thanked the members for the kindness which he had received at their hands. He then proposed a vote of thanks to the Secretary, Mr. T. Cole, for the able manner in which he had performed his duties.

Mr. S. GLOVER seconded the motion, which was carried unanimously, and suitably acknowledged by Mr. COLE.

ALTERATION OF THE RULES.

A Special Meeting, confined to members of the Institution, was held at the conclusion of the general meeting, for the purpose of considering certain alterations in the rules which were proposed by the Council.

The PRESIDENT explained that the alterations (which were set out in a circular sent to all the members) were twofold. In the first place, they provided for the appointment of an Hon. Secretary, who would retire annually, but be eligible for re-election; secondly, they would give power to the Council to invest the funds of the Institution in the ordinary stock of any gas or water company at their discretion. He would move that the proposed alterations be approved.

Mr. HUNT suggested that the two points should be dealt with separately.

The PRESIDENT assented to this, and moved that the proposed alteration providing for the appointment of an Hon. Secretary be approved.

Mr. FOULIS seconded the motion, and further explained the reasons which weighed with the Council in making the recommendation.

The motion was carried unanimously.

After some observations by Mr. HUNT, Mr. TREWBY, and Mr. H. D. ELLIS, adverse to the proposal to authorize investments in gas and water companies' shares, it was suggested that the matter should be withdrawn.

The PRESIDENT said there was no desire on the part of the Council to press it.

The motion for the adoption of the alteration was then put, and negatived with as much unanimity as the previous proposal had been accepted.

PAPERS AND DISCUSSIONS.

HIGH-PRESSURE SYSTEM OF DISTRIBUTION.

By FLETCHER W. STEVENSON, of Sheffield.

In large gas undertakings having more than one manufacturing station, there will usually be provided pressure-mains connecting the stations, to enable one to assist another in the case of an emergency such as may occur through local fogs, &c. This main may be utilized to supply *en route*, or as an extension, an isolated gasholder station; and governors may be supplied from it. The system of mains which are thus kept under gasholder pressure the author terms the "high-pressure system of distribution."

A system of distribution under pressure may be necessary even where only one works exists, owing to geographical conditions, or from the prohibitive cost of the large size of mains required to distribute from one place all the governed gas required during the few hours a day of heaviest demand. Without describing the various ways in which high-pressure systems may be carried out, which, like most other things, depend largely on local circumstances, the author ventures to describe that in use at Sheffield.

The Sheffield Gas Company have two manufacturing stations. The larger (Neepsend) has a maximum producing capacity of $8\frac{1}{2}$ millions and a storage of $6\frac{1}{4}$ millions; the smaller (Effingham Street), $3\frac{3}{4}$ millions and $3\frac{1}{4}$ millions respectively. There is an isolated gasholder at Arundel Street of $\frac{3}{4}$ million capacity; and two gasholders at Grimesthorpe of a joint capacity of $3\frac{1}{2}$ millions. The total producing capacity is, therefore, $12\frac{1}{4}$ millions per diem, and the storage $13\frac{3}{4}$ millions. The utmost producing capacity has already been reached, while the delivery in 24 hours has reached 14 millions. A manufacturing station at Grimesthorpe is now in course of construction which will have an ultimate capacity of 10 millions per diem; and gasholder storage for this capacity will be provided as required at Neepsend. The difference in levels between any of the stations does not exceed 50 feet.

Originally an 18-inch diameter pressure-main was laid to connect Neepsend, Effingham Street, and the gasholder at Arundel Street. This has now been replaced by a 30 inch diameter main from Neepsend to Effingham Street, with an extension as far as an 18-inch governor at Shude Hill; and a 30-inch main laid to the new gasholders at Grimesthorpe. A 24-inch diameter branch main has also been laid to supply a 30-inch governor at Granville Hill. The total lengths of pressure-mains outside the works are 6120 yards of 30-inch, 156 yards of 24-inch, and 1220 yards of 18-inch, or a total of about $4\frac{1}{4}$ miles.

The larger works at Neepsend supply the pressure-main chiefly, but Effingham Street can do so when necessary. Neepsend is provided with a 200,000 cubic feet per hour driving exhauster to force against the pressure thrown by the upper lifts of the gasholders at Grimesthorpe and Arundel Street. The heaviest pressure thrown by these gasholders does not exceed 9 inches; and the maximum pressure at Neepsend, when driving against this pressure, is 12 inches. The minimum pressure in the main is about 3 inches, when supplied by the lightest lift of any of the gasholders.

As the new manufacturing works at Grimesthorpe come into operation, and it is necessary for them to supply the pressure-main to get rid of surplus stock, a safety bye-pass governor, similar to those in use between the inlet and outlet of gasholders, will be fixed at Neepsend, to bye-pass gas in case the valves should be accidentally shut at the same time at Grimesthorpe and Neepsend, which, with imperfect telephonic communication, is not an unlikely event.

One point should be impressed—namely, that the pressure-main should be supplied from the outlets, *not the inlets*, of the gasholders, both for the sake of obtaining a uniform quality, and in case of accident through the outlet-valve of the gasholder being closed, when gas would return from the inlet by the bye-pass safety governor, and so maintain a pressure in the main.

The two chief objections which may be raised to a system of high-pressure distribution such as has been described, appear to the author to be: (1) The risk incurred by shutting a valve, so that the supply to the pressure-main would be cut off, and the districts supplied from it thrown into darkness; and (2) the leakage due to high pressure.

With regard to the first objection, no doubt the greatest care requires to be exercised. But the same may as truly be said of every operation upon a gas-works; and the risk is certainly minimized by the use of the safety bye-pass governors referred to.

The second objection the author believes to be an hallucination. He is firmly of the opinion that leakage does not occur, save under exceptional circumstances, from the large leading mains; and if these are gas-tight at a normal pressure, they will be equally so at the higher pressures. During the past ten years, the author does not remember more than four instances of leaks upon these mains.

The configuration of Sheffield, with its narrow valleys and high hills, its narrow streets and numberless bridges, renders the laying of large mains a difficult operation; and, accentuated as these difficulties are in our days by underground pipes for cables of telephone, electric light, and electric haulage, the author ventures to think that without a system of high-pressure distribution it would be almost impossible to lay sufficiently large mains to properly supply several of the Company's districts. The Company's aim is to give a pressure of 20-10ths during heavy lighting time in all districts except such as are purely residential; and

the maximum initial pressure required to give this does not in any case, except one, exceed 25-10ths.

Discussion.

The PRESIDENT said the paper was a short one which had been prepared by his brother at his own request at rather short notice; but he was very anxious that they should have a discussion on distribution—a subject which had not come before them much for some time. He hoped the paper would prove a means of introducing such a discussion, which was all the more necessary owing to the changed condition of the streets which had recently come about in all large towns.

Mr. C. C. CARPENTER said the subject was one which had largely engaged the attention of the Chairman and Engineers of the South Metropolitan Company, more particularly with reference to the large increase in the demand for gas during the last two or three years. There was no doubt that the present system of distributing gas at a pressure which was sufficient for the consumers was an uneconomical one; and a very large increase in the carrying capacity of gas-mains might be brought about by placing them under much higher initial pressure, and isolating the earlier portion of the main from the consumers' meters. In order to do this, Mr. Stevenson had proposed the use of an exhauster; but Mr. George Livesey suggested—and the plan was in operation at one of the Company's stations throughout the whole of last winter, up to about some two months ago—the use of a Sturtevant exhauster, in preference to the positive exhauster. There were several advantages about this type of apparatus; the most important being that the safety bye-pass mentioned by the author was not necessary, because the blower not being a positive machine, there was a full gas-way whether it was revolving or not. In an ordinary exhauster, it was a positive instrument; and unless kept in motion, it acted as an efficient stop to the passage of any gas through it. With this blower, it did not matter if it was not running the full volume of gas through it. Their practice was to use it during the hours of lighting; the first operation being to open the inlet and outlet of the blower, when the gas went through at the ordinary pressure in the usual way. As the time came to put on the pressure, the blower was started; and in three or four minutes, when full speed was reached, it was supplying gas at whatever pressure might be desired. They used it to produce a pressure of something like 3 inches on the inlet, which was increased on the outlet to as much as 7 or 8 inches. The quantity dealt with by one machine was approximately 300,000 cubic feet an hour; and to do this a fan was used which was driven by a 6-horse power engine and boiler. If they compared this with the power required for an exhauster of the ordinary kind, they would see the enormous advantage of using a blower of this type. Arrangements had been made to largely extend the system; and the plans were being considered for using blowers equivalent to passing a volume of about 1½ million cubic feet an hour. It would be almost impossible to deal with this quantity in any other way—certainly, economically—than with an exhauster of the type Mr. Livesey had suggested. With regard to the objection to using high-pressure gas, he might say that for the last ten years he had had two high-pressure mains, and for part of the time three, with a pressure of 12 and 13 inches; and he only knew of one leakage. Of course, they were not distributing mains. They were about a mile long each; and the only serious leakage which occurred was due to large sewerage operations at a very busy part of the roadway. He thought there was no real danger in using gas at high pressure. There was no greater danger in using gas at a pressure of 10 or 12 inches, than at 10-10ths or 12-10ths. In reply to Mr. Stevenson, he said the inlet to the exhauster was 12 inches and the outlet 10 inches, working into a 24-inch main. The length of the main was over two miles. The diameter of the blower was about 3 ft. 6 in. or 4 feet.

Mr. GEORGE LIVESEY said he had little to add to what Mr. Carpenter had said. The difficulty arose in this way: The question was constantly coming before them of laying larger mains, in order to supply the extremities of their district. They had a number of large mains leading out of the different distributing stations; and the idea occurred to him to have some independent mains. The one Mr. Carpenter spoke of was an independent main leading to Clapham Junction—laid for the sole purpose of helping the supply at that place, which was rather a low district with a large consumption. It was a 24-inch main at the station, and gradually the lower end of it got to 18 inches. The main was practically independent; there being only one or two connections on it. By cutting these off, it was made actually independent. The idea was to put the gas into the main at high pressure, and deliver it straight into the district. Of course, a 6-inch pressure would never do where there were wet meters, because it would blow the water out. But by the time the gas was delivered, it got to something like 3 or 4 inches at the end of two miles; and then it went into the whole distributing arrangements. It was more effective than was anticipated. It backed up the other governors, and got them completely over the difficulty they were in about the supply at Clapham Junction; enabling them to give just the amount of pressure that was necessary. The idea at first was to have an ordinary exhauster; but this seemed so cumbrous that one day passing the Sturtevant blower office in Queen Victoria Street, he called in and looked at it. Mr. Carpenter went to make arrangements; and within a week the whole thing was put together. He got the blower and the engine; and it was in just before Christmas. His idea at first was to have bye-pass valves; but on mentioning it to Mr. Carpenter, he said there was no valve necessary, because even when stopped the gas would flow through without any difficulty. The intention was to make use of the system for supplying pressure to the districts through independent mains. There were certain mains which could be made independent for several miles; and they would be made use of for delivering gas at high pressure to the extremity. Since the introduction of large holders, they were placed in this difficulty: When the upper lifts landed, there was not pressure enough to supply all the district. Taking their own storage at something like 45 million cubic feet, the last 10 to 15 millions was of very little use. If they had a very large demand for gas, and the upper lifts landed (say) at 7 or 8 o'clock, the one lift had not sufficient pressure to supply the district. By adopting this plan—putting one of the Sturtevant blowers on the outlet of the gasholder leading to the governors—they could put on just what pressure they liked. He had suggested that Mr. Carpenter should read a paper on the subject; but it was thought it would be better to wait until after the experience of another winter.

Mr. G. C. TREWBY said that all the Beckton gas had to be pumped up to London. When the works were first laid out, it was with one 48-inch main; and all they could give them was a gasholder pressure of about 6 inches. In the course of a year or two, it was found that this was not sufficient in London; and then exhausters were put on—ordinary Beale exhausters, and the gas was pumped up. Now they had a second 48-inch main; and every foot of gas sent away from Beckton was pumped, because the gasholder pressure merely would not be of the slightest use. It was not an uncommon occurrence in winter time to put 24 inches pressure on the main at Beckton, in order to get sufficient pressure in London. The whole of the works were connected together by this high-pressure system, with the exception of Kensal Green, which stood quite alone. The advantage was that any works in the district apportioned to it which had a greater demand than it could supply, could draw from the Beckton main, and put the gas either directly into the district or else into their holders. He did not know why they should stop at 24 inches pressure—after all, it was a mere nothing; he did not see why they should not go to something like 48 inches. Everyone knew that leakage did not vary directly with the pressure. Therefore, as long as the mains were examined from time to time, there was no fear of leakage. They had a very large system of distribution on their high-pressure mains (their gas was corrected to 60° Fahr., so that they had the additional disadvantage of not accounting for the whole of the gas by about 2½ per cent.); and yet the unaccounted-for gas was not more than the general run of undertakings throughout the country. He did not know whether Mr. Stevenson had any particulars as to the cost per 1000 cubic feet of pumping the gas. He had occasion to work it out some time ago; and it came to about 0·2d. per 1000 cubic feet. When one considered that by this means they were more than doubling the capacity of the main, there seemed to be great economy in the method.

Mr. FOULIS asked if the gas under 24-inch pressure was delivered into the distributing mains, or to the holders.

Mr. TREWBY said at the town-end it either went into the gasholders in the daytime or through the governors into the distributing mains.

The PRESIDENT presumed the 24 inches pressure was due to the friction in the mains—the resistance; it was not gasholder pressure.

Mr. TREWBY replied that the resistance was due to the quantity of the gas sent through, and the friction of the main.

Mr. FOULIS said that at one of their largest works, where they sent out in winter about a million cubic feet an hour, the gas went through two high-pressure mains—one about three and the other about two miles long. Thence it was distributed through governors. They put the full gasholder pressure on—all that they could get. The discussion would certainly be very useful to him, because he was contemplating laying another 4-foot main into the town; and if he could manage it by putting on such a blower as Mr. Carpenter had suggested, it would save a good deal of expense.

Mr. W. R. HERRING (Edinburgh) said this principle of pressure must have occupied the minds of most of them. At the present day, the streets were so much crowded with tramways, electric traction, and all sorts of things, that there was very little room left for gas companies; and they would have to devise some means of conveying the gas other than using enormous mains and working at low pressure. In Edinburgh, their position was somewhat similar to that of Mr. Stevenson. Their gasholder stations were scattered throughout the district; and they had to supply them by exhausters from the various works. It recently became necessary to lay some large mains in a new district, as the town was growing rapidly; and the difficulty arose as to getting a main there, because they would have to pass through the heart of the city. He found, after inquiry, that they had a 24-inch main supplying gasholders passing near where there was a junction; and it occurred to him they might put in an underground governor, and supply it from this point. They did so, and supplied a 15-inch main under gasholder pressure merely. The pressure in the district was most uniform. The governor was quite a success; and it had saved the laying of £1200 or £1500 worth of mains. They thought of bringing a pressure-pipe back to the works; the governor being three-quarters-of-a-mile off. But he believed this system was capable of enlargement; and they would be almost compelled to adopt it under new conditions in Edinburgh. The works were at the extreme corner of the district; and the trunk main going to some of the present gasholder stations would no doubt be used and utilized in a way to supply district governors from the leading main. Instead of taking pressure-pipes back to the works, he should propose acquiring a cottage somewhere on the road (where they could put in a pensioned-off workman). There should be a pressure-chamber—the governor itself being underground; and the man's duty would be to actuate it. In this way, they might save a considerable outlay on the distribution of gas in future.

Mr. T. GLOVER (West Bromwich) said he did not think the discussion would be complete unless it was mentioned that an apparatus had been devised for the controlling of pressure by electric means from a low-pressure system to the works; so that the gas could be started through a high-pressure main, and the pressure kept constant in the district. He thought such an apparatus would lend itself to the use of high-pressure distribution with a constant pressure in the low-pressure mains, which was so very desirable for consumers.

Mr. C. E. BOTLEY (Hastings) said he had been able at Hastings to obtain uniform pressure without any mechanical means, though there were great differences in elevation. The highest point was about 650 feet above the works level, which was just above Ordnance datum; and part of the district fell below that datum, so that it was rather difficult to get equal pressure over the whole district. By very simple means, however, they had overcome the difficulty to a large extent. Periodical testings of pressure showed that the variations were not very great, especially at night. In the daytime there was an excess of pressure on the hills; but at night, when the draught came on, and the consumption increased, it was equalized to a very large extent. Hastings was a sea-front town with a number of valleys running up to the tableland on the top, with side valleys in between them, and ups and downs of various descriptions—in fact, hill and dale all over the place. When the gas rose up a hill of this kind in the big trunk mains, of course they endeavoured to keep it generally at a high pressure; and they connected the subsidiary streets by smaller pipes—if necessary cutting the main asunder, and putting on a short connecting-piece. By making connections of this kind, they had fairly equal pressures throughout the whole of the district. In addition to this, they found it at an advantage, at the extreme end of the district, instead of putting down what would be considered an ordinary sized pipe for supplying the gas required, to put in a larger pipe in proportion, so that they had a sort of nucleus of gas there, which made a cushion for the incoming gas to work against, and, so to speak, keep the pressure constant. During the past winter he had some continuous testings made for another purpose, and had been surprised to find within what a few inches the pressure could be kept over a district of this kind without any mechanical means beyond the natural contour of the ground. With regard to the high-pressure mains spoken of, he should like to ask whether driving the gas would not tend to impoverish it, owing to friction in the mains.

Mr. F. D. MARSHALL (Copenhagen) asked if there would be any objection to sucking the gas instead of driving it—putting the engine or exhauster somewhere at the far end of the district. He did not mean to say that they could produce an absolute vacuum; but to suck the gas through the main would perhaps be cheaper than forcing it.

Mr. STEVENSON remarked that they could not alter the capacity of the main by sucking.

Mr. FOULIS: It could only be done if there were sufficient initial pressure.

Mr. MARSHALL said Mr. Irminger, whom he was sorry not to see present, was doing practically the same thing. He could not push the gas through, but he was sucking it from the holders at the works and distributing it through a supplementary station to the district which he would otherwise be unable to supply. Such a plan would get over the difficulty of the high pressure in the mains, which seemed to be rather a bugbear, and would avoid what Mr. Botley had suggested—a possible loss in the illuminating power. He had had no experience of it; but he knew that Mr. Irminger had; and he should like to know if anyone in England had tried it.

Mr. F. W. CROSS (Leyton) said he read a paper at Edinburgh in 1895 on the equalization of pressure in Victoria, Hong Kong. There they had been trying the means the previous speaker had mentioned. They wished to add to their storage capacity, but could not obtain ground near the works, and had to put their holder from 2½ to 3 miles away; the ground between being perfectly level on the sea side. The holder was supplied from the ordinary mains of the district, except for a quarter-of-a-mile close to it. The mains in the district were only 4-inch; so they laid a 10-inch main for a quarter-of-a-mile, and the gas was supplied from the works during the daytime at a normal pressure of 10 inches. When they erected the holder, they put exhausting plant in a house adjoining it, and drew the gas through the town main while the consumption was going on. The increased pressure required at the works was about 3-10ths; and it pulled the gas through the ordinary town main without affecting the consumption in the slightest. Half way on the main there was a gas-engine driving electrical plant belonging to one of the cable companies; and this engine was never affected. It always had sufficient pressure while they were sucking gas through the main into the holder.

Mr. S. MEUNIER (Stockport) said the paper was likely to be of use to all the members. In the cases cited, both at Sheffield and elsewhere, they had gas distribution at high pressure by special mains, which fortunately the Engineers had been able to utilize; but it must not be forgotten that (unlike the case of electric light supply, where they had an entirely new thing, and could put up a high-pressure feeder and a low-pressure distributor), gas companies, having been in existence much longer, had in many instances their mains already laid down, and it was not possible in every case to have either gasholders in various parts of the district or distributing stations. Taking his own town, the only high-pressure main they had was one from the High Street to the works, which was practically only a short length going through the immediate centre of the town. This portion did not need any further supply; but they certainly did find great difficulty in keeping up the service

to the outlying districts, which were very rapidly growing. The mains had probably been in existence some twenty or thirty years, and now required either enlargement or some steps to be taken to keep up the supply. He was, therefore, very pleased to hear the paper, as it would save a large amount of money if it were possible to put down a drawing instead of a forcing apparatus somewhere on the outskirts, and get a good quantity of gas. This would enable them to overcome a difficulty which he could not see a way of accomplishing by any high-pressure mains. As far as leakage was concerned, he had never noticed any in the one high-pressure main he had, which was a mile-and-a-quarter long with 12 inches pressure.

Mr. T. S. Lacey (Pimlico) said that connected with one of the stations of The Gaslight and Coke Company they had a blower for pulling the gas in and out of the holder. In that Company, the whole of the 100 million cubic feet of storage was common property. It would be impossible for them to adjust the supply in the winter unless the different stations could interchange. In order to do this, they had holders at the works and also in other parts of London, where they not only pumped gas in, but could pump it out at will. It did not matter whether they pulled it in or forced it in. The use of a blower as a gas exhauster was a matter in which he was much interested. Some years ago he mentioned to Mr. Donkin that a gas exhauster was not a proper appliance to use for low pressure; and it was well known to every one who had experimented with exhausters, that they did not give proper efficiency at any pressure under 15 or 20 inches. When the water pressure amounted to about 40 inches, with a good gas exhauster one could get a mechanical efficiency of about 80 per cent. for the entire apparatus—engine and all. But when the pressure fell to 10 or 15 inches, the whole work done was simply the friction of the apparatus; and he had no hesitation in saying that the mechanical efficiency of an ordinary blower at 10 inches pressure would be far beyond that of the best exhauster. They had to use pressures considerably above 15 inches; but nevertheless he believed the blower was the most scientific instrument for pumping gas. It could be done in two steps. They could pump up to 15 inches with one apparatus, and then take it up higher with another. He did not see any reason why a very cheap and compact apparatus like this should not be used for dealing with a large quantity of gas; and he congratulated Mr. Livesey on the step he had taken, which he believed was one in the right direction. Another thing which struck him was that when mains perhaps four or five miles long, and 40 inches in diameter, came into use for distribution, there was no reason why this should not be continued inside a building. If they were going to send the gas four or five miles, they would want 48 inches pressure; but when they came to buildings, the connections might be very considerably reduced, and also the valves, and thus a large saving might be effected without in any way sacrificing the efficiency of the plant. Using such an instrument as Parsons's turbine or fan, one would be surprised at the amount of work it was possible to do in a very limited space. If people wanted to pump gas, it would be much cheaper to use a rotary instrument like this, with a fan, instead of an exhauster, which was a most unsuitable and extravagant machine.

The President said it was very gratifying to find this subject had created such interest, and that so much personal experience of different kinds had been brought forward. No doubt the means adopted to supply gas under high pressure, as well as to utilize the pressure in the mains to increase their capacity, was a subject capable of application in an endless variety of ways. They might have a machine for driving gas through a main under pressure, or they might suck it by other means, and then deliver it at a high pressure. They might also, as Mr. Cross had indicated—if the distributing mains were large enough—even abstract from them a certain portion of the gas, and deliver it by a blowing or driving machine into another neighbourhood. The discussion showed one thing at any rate—that there was no danger to be feared from the use of high-pressure mains. This was a very important point, because as to their economy there could be no question. One great thing was to make it clearly understood that by adopting high pressures in their holders, or even higher pressures in certain mains not connected with the distribution, they were not placing the inhabitants of a town in danger from undue leakage or possible explosion.

Mr. Stevenson said there was not much to reply to. This was one of those cases in which a very short and simple paper had elicited a great deal of information from other members; and it showed the use and interest of such meetings as this. He was particularly interested in what Mr. Livesey and Mr. Carpenter had said as to driving, not by an exhauster, but by a blower, and the greater quantity of gas which could be put through the main. At Sheffield, they had a 30-inch main by which he distributed 200,000 cubic feet an hour.

Mr. Carpenter remarked that theirs was a 24-inch main, which delivered 300,000 cubic feet an hour.

Mr. Stevenson said that there had been a difficulty in his mind about this 30-inch main—viz., when they were making their full capacity how they were going to get rid of it. But from what Mr. Carpenter had said, there would be no difficulty at all. They could get a far larger quantity through than he had any idea of. He could not give the cost of pumping, as he had not taken it out; but it must be very small indeed. The largest item would be the fuel required for raising steam; but the fuel they used cost nothing—in fact, they would have to pay to get rid of it. With regard to the question of sucking, if they were exhausting through a mile of main, and supplying a governor while so doing, they would have to maintain 3 inches of pressure. The object of high-pressure mains must be to get a greater quantity of gas through. They would not be allowed for any other reason. Sheffield was peculiarly situated, with narrow valleys, with streams running down, and there was the greatest difficulty in laying a large main—in fact, in the main street going from the Neepsend works he hardly thought it possible to get in another pipe. They were obliged to get rid of the gas there under pressure. Mr. Botley had referred to a difference of altitude of 650 feet, and had explained how he reduced the pressure by small connections. At Sheffield they had altitudes varying up to 800 feet, and even rather more than 900 feet. From diagrams which were taken comparatively recently, he found that during the daytime perhaps for twenty years the pressure was exceedingly high. But during the last two or three years in some of the smaller mains it was hardly sufficient; and therefore the line he went upon now was to lay mains large enough and re-govern the gas.

The President said that Mr. E. Drory, of Berlin, had prepared the next paper; but as he was absent, it would be read by Mr. Woodall.

OBSERVATIONS UPON THE CONSTRUCTION AND WORKING OF INCLINED RETORTS.

By E. Drory, of Berlin.

Although much has already been written about inclined retorts, their installation, cost of working, &c., the author ventures to communicate some information on this subject, which, drawn from Continental experience, and representing Continental views, may not be without interest.

At Berlin, 26 furnaces with inclined retorts were erected in the course of last summer; and all but two furnaces were brought into action last winter. Each setting contains 9 retorts, 15½ feet long. Unfortunately, neither in Vienna nor in Berlin did the circumstances permit the erection of new retort-houses, specially designed for inclined retorts; and the existing ones, originally built for horizontals, offer by no means favourable conditions, either for ventilation or the manipulation of coal and coke. At Berlin, in spite of these drawbacks, a saving in wages of 1s. 8½d. per ton of coal, or about £5000 per annum, was effected, as well as economizing nearly the same amount in fuel. A return of 20 per cent. on the capital expended on these benches may, therefore, be looked for. The average production of gas per retort and per day was 12,700 cubic feet with Durham coal, and 14,000 cubic feet with an addition of 15 per cent. of Silesian coal—the duration of charge being 4 hours 48 minutes. It is not necessary to enter further into the details of working results and economy, as the cost of labour and materials, and the conditions of working on the Continent differ so entirely from those in England that a comparison is hardly possible.

The following remarks are restricted to the actual working and construction of inclined retorts, and embody the author's experience of nine years. One principle adopted was the avoidance of all expense beyond that strictly

necessary to secure good and reliable work; but, on the other hand, there was free expenditure, where the prospect of economy in labour seemed to justify the capital outlay.

1.—*Manipulation of Coal.*

On a works where the slopers form the total, or a considerable part of the gas-producing plant, it is advisable, for the sake of security, to have the engines, coal-crushers, and elevators, in duplicate. Where there are two parallel rows of benches (as at Berlin), the engines should be placed in a central position, so that one or either is able to drive one or either crusher and elevator, and these latter able to feed either row of benches. Many engineers will feel quite safe with a single set of apparatus, merely having duplicate pieces of the moveable parts of the machinery in stock. Once in Vienna the steam-engine driving a coal-crusher broke down in such a manner that repair *in situ* was not possible. The consequence was that the whole machinery had to be put out of action for a fortnight. A similar accident might occur anywhere, and unexpectedly (accidents being usually of this kind), either to the engines or elevators, which are the parts of the greatest importance.

Two systems of coal-crushers are in use at Berlin and Vienna—viz., with rollers and with jaws respectively. These latter have proved themselves preferable, as they will crush any sort of coal, including the hard Continental and cannel, with almost equal ease, which cannot be said of the roller crusher. One jaw-crusher at Berlin disposes of more than 1 ton of coal a minute.

There are also two systems of elevators, the bucket elevator and the hydraulic lift for coal-trucks. Where the coal has to be broken, the first one seems to be the handier, as it will automatically draw away the broken coal from under the crusher.

Coal-hoppers have been provided above and along the whole length of the benches. The outlay entailed by this arrangement has been considered too high by some Continental engineers; but it is soon repaid by the economy in labour—the transport of coal in front of the hot furnaces being avoided. For delivering the coal into the hoppers (in Vienna and Berlin) conveyors have been used, as well as trucks running on rails. There is little doubt that a conveyor is the more suitable of the two, and does not necessitate heavily constructed hoppers to carry the rails and trucks, nor require so many men to work it. All the mechanical appliances for coal have proved very reliable, and the wear and tear on them is moderate.

2.—*Charging of Retorts.*

When the coal falls from the conveyor into the hopper, it forms into heaps, on the sides of which the large lumps tumble down; the fine coal remaining in the middle. The coal in the hopper, therefore, varies in size. Supposing the charging apparatus to be perfectly automatic, it would require to be continually adjusted to suit the different sizes of coal; and this would be, to say the least, difficult. The author, therefore, does not make his charging apparatus of the completely automatic type, but relies to a certain extent on the intelligence of the workman. This man, standing on an elevated platform, has all three rows of retorts well under his observation, and can easily control the charging, and after the carbonization is complete, observe the layer of coke in the retorts. The shoots, which are lifted into the mouthpieces by means of a lever, are made at such an angle that coal of average size will just charge the retorts properly from top to bottom. Such regulating as is necessary is done by the workman with a horizontal slide-valve fixed between the measuring chamber and the shoot. With a little practice, a man will get so accustomed to this regulating work, that he will charge one hour English coal, the next Silesian coal, and the next again Westphalian coal with equal ease.

It is not desirable that one and the same amount of coal be charged in every retort *coûte que coûte*. Large and dry coal runs down quickly and carbonizes easily; and a heavier charge is necessary than in the case of fine and wet coal. In every case the retorts receive the charge of coal necessary to fill them up to the top. It would appear that the difficulty in England is to make the stoker charge a sufficiently large quantity of coal. This is certainly not so either in Germany or Austria. The men retain so much of the discipline of their military service that, as a rule, they do their work conscientiously, especially if there is a good foreman; and as only a few men are required for charging, it is easy to select the pick of the yard for this purpose.

3.—*Manipulation of Coke.*

The successful economical working of an installation of slopers depends in a great measure on the ease with which the discharging can be done, and the coke disposed of. Different sorts of coal give sometimes very varying results. Silesian and Moravian coal does not swell during carbonization, and the coke slides out easily when slightly pushed from above. Several coals of the Durham district do not give much trouble either, although they swell during carbonization; whereas others make a deal of pricking-up from below necessary. The same trouble was experienced with Westphalian coal. As this difficulty cannot well be overcome, there is all the more reason for making the quenching and disposing of the coke as perfect as possible.

Where the working floor of the retort-house is on the ground-level, and the coke quenched where it falls, the men are greatly hindered by the heaps of coke. On the other hand, where there is a stage-floor, and the coke falls through openings into trucks and is quenched therein, they suffer considerably from the steam and smoke, both above and below. Indeed, the men protested against this method in Berlin. It also entails a considerable amount of labour, as the trucks have to keep pace with the rapid discharging of the retorts. The system which appears best adapted to avoid these drawbacks is the "De Brouwer trough," which is at work at Bruges and the Hague, and is in course of installation at Cassel and Charlottenburg, near Berlin. The conveyor in the trough takes away the coke to the heap automatically, quenching it gradually on the way, and sending up the vapour near the front of the benches. Consequently the work at the retorts can be proceeded with without hindrance or interruption.

4.—*The Retort-House.*

The construction of the retort-house is also a matter of great importance. There is no doubt that considerable economy can be realized, and much can be done for the general comfort of the men, if, instead of the old-fashioned retort-house, a construction were attempted somewhat better adapted to the peculiar working conditions of the inclined retorts. This is by no means an easy task; for the human mind clings persistently to the customary and the conventional, and needs time to find the form adequate to the new idea.

The chief thing is to know clearly the main features desirable in a retort-house for inclined retorts. The author's objects in this respect were simply these: Protection against wind and rain for the furnaces; protection against heat, smoke, and vapours for the men. Obviously, these aims are nearest attained the closer the roof and walls approach the furnaces, and consequently, the nearer the men get to the open air. The design of the retort-house now to be described is a result of the above train of ideas.

The two rows of furnaces, 30 feet apart, and the elevated sides face to face, form, together with the gable walls, a kind of open courtyard. The men on the top of the stage-floor, who have a good deal to suffer from the heat (being obliged to stand rather close to the furnace) are thus protected against wind, but have plenty of fresh air. On the lower side of the furnaces, above the bottom stage-floor, the retort-house walls (iron girders in concrete) are built at a distance of only 4 feet from the furnaces. Sliding doors are provided in front of the retorts, which are pushed aside during the time of discharging. The men, who have no particularly hard work to do, are practically as much in the open air as their comrades in the coal or coke yard, and much prefer this to the smoky retort-house. In Vienna, a small roof was at first erected, to protect them against snow and rain; but the men soon found that they were much better off in the open air, and asked to have it taken away, which was done. Since then they have worked there several winters and summers with satisfaction. Frost can do no harm, there being no hydraulic machinery to be affected by it; and in the event of a very heavy rain, the charges may be postponed for a quarter of an hour.

In the highest part of the roof, just above the low side of the furnace, an aperture is left, 6 feet wide, the whole length of the bench, which, acting as a chimney, will easily draw away the vapours, as well of the top as of the

bottom mouthpieces. At Berlin, where the slopers are built in an old retort-house with a semi-circular roof, the top of which forms the centre-line of the two rows of benches, the vapours from the furnace stream across the top stage towards the middle, to the great inconvenience of the men.

It is evident that a retort-house especially designed for slopers cannot cost much. The covered area is but small; walls and roof, very light; and foundations, next to nothing. This fact can but favourably affect the original outlay for slopers as compared with other systems of gas production.

5.—*Furnace.*

The adoption of a generator is necessary for a furnace with inclined retorts. The simple fire-bar system is not to be recommended, as no uniform heat is obtainable thereby, especially with retorts 15 or 20 feet in length. Particular care must be taken in the construction of the setting, as well as of the stays for keeping it in its position. The retorts, the generator, and the regenerator should have separate stays.

It is also very essential that the fuel gas leaves the generator at as low a temperature as possible, so that the arches which have to carry the weight of the setting should not suffer too much. For this it is necessary always to keep a uniform layer of 4 to 5 feet of fuel; to keep the generator perfectly tight, so that no air can enter through a leak and cause combustion in the wrong place; and to evaporate about 1 lb. of water under the fire-bars per pound of coke used as fuel.

If the combustion is a dry one, the gaseous fuel leaves the generator at a temperature of about 2500° Fahr. If a sufficient quantity of water is evaporated, this temperature will be only 1800° Fahr. In the latter case, moreover, the slag is quite soft, so that the fire-bars only want cleaning once in 48 hours. The opening through which the generator is fed must be as large as a retort mouthpiece, in order to get the large lumps of coke easily through. The regenerator must be of such ample construction that the heated air leaves the last flue at a temperature of 1600° Fahr.; and the waste gases must not have more than 900° Fahr. when entering the chimney.

As to the interior of the setting, the supports which carry the retorts should not be more than 8 inches apart, as otherwise the retorts are liable to crack; and the joints of the retort-lengths should be perpendicular, so that they just come in the middle of a support.

The correct distribution of the heat is of the greatest importance. The retorts should not be too hot in one part, especially near the bottom mouthpiece, as otherwise stopped ascension-pipes and thick tar in the hydraulic main will be the result. A uniform heat is secured by covering up 6 inches of the intermediate spaces of 8 inches between the supports on the level of the upper retorts. By these means a slight pressure is obtained in the furnace, resulting in a uniform distribution of the fuel gas through the relatively small apertures. This is on much the same principle as the rose of a watering pot, which with a high pressure and numerous small holes gives off a uniform distribution of the water, whereas one with relatively large holes and low pressure gives it off in an irregular way. Apart from this, there is a damper in the main flue leading from the generator to the furnace, which allows the fuel gas to be forced either more towards the upper or lower parts, as may be necessary according to the sort of coal used.

6.—*Quality of the Gas.*

The illuminating power of the gas produced with slopers of 15½ feet length is the same as that produced with horizontals 8 feet long.

7.—*Advantages of the System.*

Inclined retorts have the advantage of being able to produce gas of good quality and in large quantities on a small area of ground. They effect considerable economy in labour. In a modern, well ventilated retort-house, provided with a De Brouwer's trough, certainly not more than five men are necessary for working 180 mouthpieces, including charging and discharging of retorts, and quenching and taking out of coke; and one extra man is sufficient for attending to ten fires. But the great advantage of the slopers lies in the fact that neither skilled nor heavy manual labour is any longer required in the retort-house. The old stokers, who enjoyed all sorts of privileges, and often felt themselves the real masters both of the works and of the situation, have disappeared, and with them a great deal of the engineer's trouble and anxiety. The few men left, knowing that they can be replaced without difficulty, do their best to give satisfaction to their employers, and thereby retain their well-paid and easy work. It is, therefore, not to be wondered at that the popularity of slopers, and the increased demand for them on the Continent—especially in Germany—is growing apace.

Mr. Woodall expressed his regret that he had to leave the meeting; but he understood Mr. Marshall's paper was going to be read next, and he hoped to be back in time to take part in the discussion. If he could not, Mr. Herring, who had seen the retorts, would take his place in replying. He might say that when he designed the arrangement in Berlin, inclined retorts were almost necessarily adopted, because the house, which was about 100 feet in height, already existed, and it was a question of producing in the same area at least as much gas as they were then sending out, by taking out the benches which were set at right angles to the axis of the house, and putting in parallel benches. He was not able, with mechanical stokers, to get width enough; and therefore they put in the two parallel rows of inclined retorts. This showed one of the advantages referred to in the paper—the larger quantity of gas to be obtained from the same area. The house did not lend itself very well to ventilation on a large scale; but this was a matter he hoped they would be able to deal with after a few further experiments. The necessity for free and thorough ventilation with inclined retorts was no doubt great, because the heat on the charging stages was so considerable—especially when they were placed *dos-à-dos*, so that the heat came from both sides on the men engaged on the platform in the middle; and special precautions must be taken to bring in sufficient air for the men's comfort in working. It was different when a single bench was placed in a narrow house, where the men could be placed against the outer wall, and an abundant amount of ventilation could be obtained through openings. One matter which he hoped would receive due attention in the discussion was the difficulty experienced more or less everywhere, but to a very varying extent, with regard to the creeping of coal from the upper end of the retorts down towards the mouth. He had had under observation the last four or five months a bench of retorts, admirably set and in perfect order, where the upper portion was almost invariably found to be empty at the end of the charge. The coal was drawn down towards the mouth, and, of course, became more difficult to burn off. The effect on the setting was bad, because the heat at the upper end became excessive; and the discomfort of the men was increased. This tendency to slip existed more in the case of some coal than others; and it had been suggested that morning by Mr. Braidwood, who had had large experience, that it probably had a great deal to do with the form of the retort itself. Against this, in the bench he (Mr. Woodall) referred to, the retorts were all the same section; but with some coals there was this creeping to a large extent, with some there was much less, and with some others there was hardly any at all. It was not a matter which could be connected with the charging of the retorts. It did not take place at the time of charging, but after the retort had been closed. He had no doubt that an explanation would be forthcoming; and if they could find the scientific reason for the action, it would be a long step towards getting some means of dealing with it.

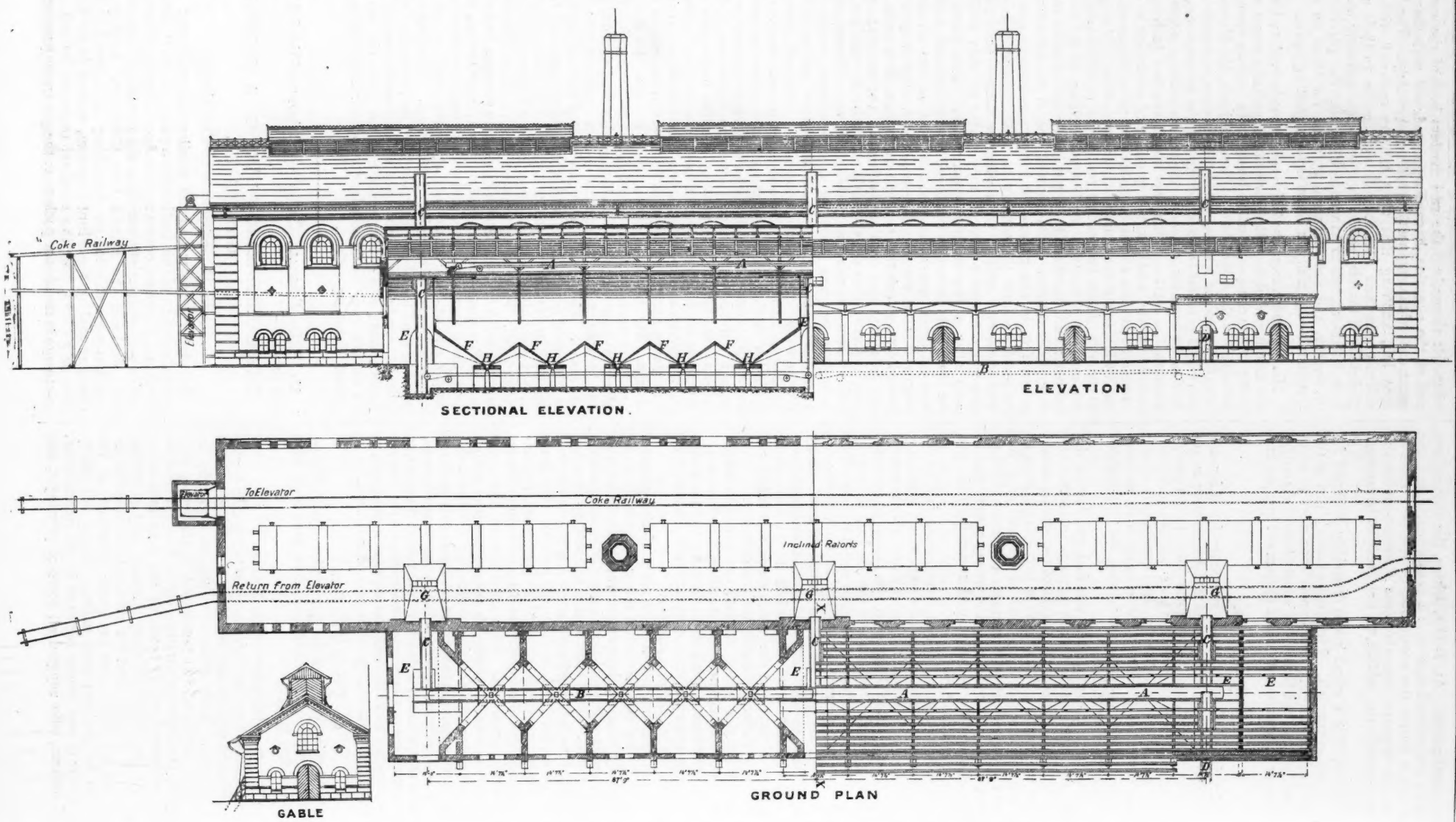
Mr. F. D. Marshall (Copenhagen) then read the following paper:—

THE CARBONIZING PLANT OF A MODERN GAS-WORKS.

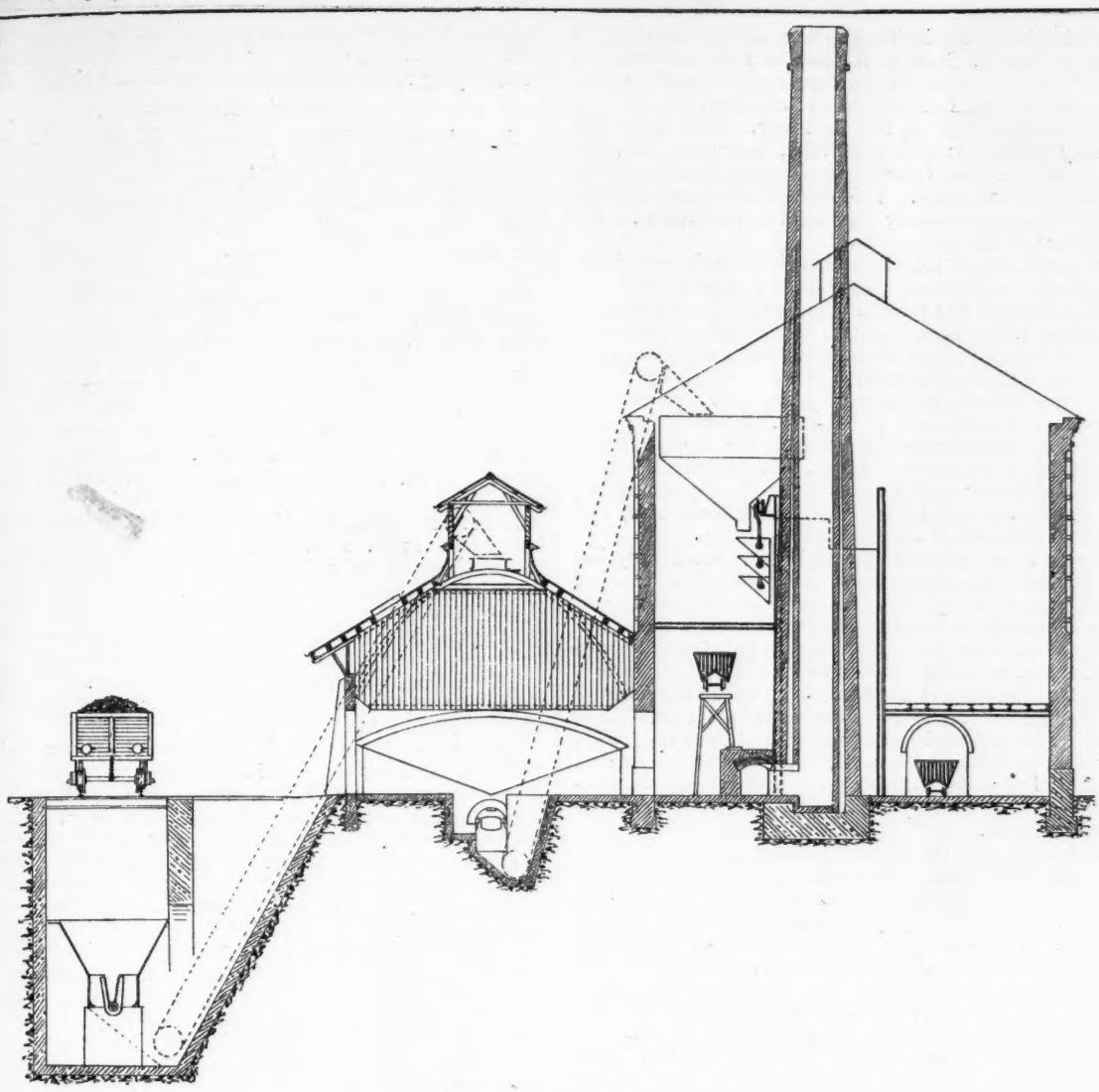
By F. D. Marshall, of Copenhagen.

In 1896 the writer had the privilege of reading at the annual meeting of this Institution a paper on the "Monier System of Cement Construction as Applied to Gas-Works," with a partial description of the coal-stores at the Frederiksberg works of the Danish Gas Company. Last year, facilities were afforded for describing the method of discharging coal by the Hunt's system, storing in the large bins or pockets, and the eventual transport by rail and re-storage in the bins or pockets at the gas-works previously

COAL STORE FITTED WITH WEST-MARSHALL PATENT AUTOMATIC FILLING AND EMPTYING MACHINERY.



A. Filling conveyor. B. Emptying conveyor. C. Elevator from emptying conveyor to coal hopper. D. Elevator from tipping hopper to coal-store. E. Engine-room.
F. Monier arches. G. Coal-hopper. H. Emptying regulators.



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alluded to. It is now proposed to bring the carbonizing plant at the same works to your notice; and, if permitted, the writer hopes at some future time to complete the series, by describing the coke-handling methods employed.

Coal Storage Plant.

For the sake of clearness and sequence, it may perhaps be permitted to shortly recapitulate the course of the coal, from the moment of arriving by steamer, until placed ready for use in the retort-house.

The coal is lifted, as described in last year's paper, by the 2-ton Hunt's grabs, and stored in the Monier bins or "pockets" at the harbour. This machinery, it may be remarked, has now been in use for some time; and it is even more successful than was anticipated—the cost of unloading and storing being lower than previously quoted.

Anyone interested in the matter is invited to inspect this unique and labour-saving installation, which will well repay a visit, even at such a distance as Copenhagen.

From the large stores at the harbour, the coal is conveyed daily by train to the smaller stores on the works, which contain a week's supply, or about 1000 tons. The coal-trucks, each containing 10 tons, are specially constructed with flap-doors in the bottom. They are run over a pit, and the contents dumped into the same. The coals, after passing the crusher, are elevated at the rate of 1 ton per minute, and deposited by means of the overhead conveyor in the funnel-shaped "pockets" or bins of the store, which were minutely described in the paper of 1896. From the bins, the coal is transferred by the lower conveyor band to the three elevators supplying the hoppers in the retort-house.

At the time of reading the paper describing this machinery, the writer was not in a position to quote exactly the cost of handling and storing the coal by this method. Since then, however, the exact figures have been ascertained; and as they may prove interesting, they are given below. By the aid of two men, 120 tons of coal are handled—that is to say, they are received, crushed, and stored at the rate of 1 ton per minute, and simultaneously removed from the store and conveyed to the retort-house at a like rate. The train conveying the coal to the works consists generally of from ten to fourteen wagons, containing from 100 to 140 tons; and this quantity, allowing time for shifting trucks, is disposed of in about 3 to 3½ hours. The installation is successful to a degree; and it has not failed for a single hour since started three years ago. The wear and tear is inappreciable; and the question of labour (sorrowful as it is to say so) is reduced to a vanishing point.

Referring to the matter of prime cost, the question will be asked, Can such an installation pay? Here are the figures based on the fact of the installation having cost complete £3500, and destined to handle 30,000 tons of coal annually—

One man, storing, three hours daily, supplying hoppers in retort-house and clearing up, looking to engine, &c., three hours daily, at 3½d. per hour, say, annually	£33
Two men shifting trucks, three hours each at 3½d.	33
Oil waste, brooms, annually.	30
Depreciation on £3500 at 2 per cent.	70
Interest on £3500 at 4 per cent.	140
	£306

On an annual quantity of 30,000 tons this equals 2·44d. per ton, for unloading, storing, supplying retort-house, and including wear and tear and interest on capital.

Carbonizing Plant.

The immediate object of this paper is to describe the carbonizing plant of the works in question, which are equipped with a complete and perfect installation of inclined retorts. The writer is, perhaps, one of the pioneers

in the adoption of the inclined system of retort-setting, for after a visit to M. Coze at Rheims in 1889, he was permitted by his Directors to erect an experimental 9-retort oven, heated by a Hasse-Didier furnace, at the old Frederiksberg works of the Company. This oven was gradually perfected; and eventually, five years ago, the retort-house at the Odense works was fitted with an installation of 51 retorts. This installation, proving in the highest degree satisfactory, was used as the model for the retort-house at the new works.

The plant consists of three benches, each containing 51 retorts (five settings of 9 and one of 6 in each bench), or a total number of 153 retorts. The angle is 32°; and the dimensions of the retorts are 21 inches by 18 inches by 11 ft. 6 in. long, through the longitudinal axis. They are heated by tubular generators of special design; and such is their efficiency that last year's fuel consumption was 9·5 lbs. of coke used per 100 lbs. of coal carbonized, and the heat escaping to the main flue is barely sufficient to maintain the necessary draught. At any rate, the main flue is quite black; and the analysis of the escaping gases gives on the average 18 per cent. of carbonic acid, and about 0·20 per cent. of carbonic oxide.

The retorts are set entirely with block-stones; very few or no bricks being employed, excepting to line the furnaces. The presence of many joints, however carefully made, is a source of weakness, causing settlements, with the result that the retorts lose their alignment. This is obviated to a great extent by using block-stones instead of brickwork. Coupled to this, a less clever man can complete the setting; for, given a good drawing, and the block-stones numbered, he sets to work as happily as a child with a box of toy bricks. There are no baffle-walls, no intricate passages, and no nostrils to choke up—all being open, and easy of observation and access in every part. The result is a beautiful and uniform heat.

The sides of the retorts are parallel, excepting at the upper ends, where at the mouthpiece, for a length of about 2 feet, they are constricted in a peculiar manner; the first 2 feet having a distinctly greater angle than the body of the retort. This was found by experience to greatly assist the even distribution of the coal; and, what was of still greater moment, it induced the last portion of the coal, or that with the least speed, to adjust itself properly in the mouthpiece of the retort, and not remain on the iron.

The generator is immediately under the setting. This is a controversial question; but, having in view that the ultimate mission of a generator is to save fuel, and not to be an obstruction in the cellar, or a hindrance to coke-handling machinery, the writer is inclined to think that its proper place is under the setting.

The retorts are charged from three fixed hoppers, one to each bench, fed by the three elevators from the coal bins or pockets. These elevators are supplied by the lower conveyor band previously referred to. Each hopper contains 61 tons of coal, or twelve hours' supply for each battery. They are filled by the man in charge of the coal-store at 6 a.m. and 6 p.m.

The retorts are charged by scoops running on a light railway, three scoops to each bench (one for each tier). As the railway is continuous, the supply can be obtained from any hopper in the event of the hopper attached to any particular battery being out of repair. There is a total absence of conveyors or other machinery in the retort-house, and consequently no clatter or noise; all being of the simplest description.

The upper and middle floors are constructed of the lightest steel beams and plates, all of the most gossamer-like description—this with the idea of saving structural expenses. The house is well ventilated. The upper or charging doors are jacketed with asbestos; and there is no oppressive heat to worry the men employed.

The greatest possible attention has been paid to the hydraulic mains and over-bench fittings; all caps and openings being fitted with manhole faced doors and screws. Each hydraulic is fitted with levelling screws; and there are no loose bolts or luted joints whatever. As the writer's old friend, Mr. John West, remarked when inspecting the arrangement, "This isn't competition contract work."

A stopped pipe—that man-killing nuisance—is almost unknown; and the professional pipe-jumper is not on our staff.

The entire installation of the benches, including all iron, brickwork, and labour, was carried out by the Stettiner Chamotte (Didier) Company; and the writer has pleasure in testifying to the thoroughness exhibited throughout.

Working Results.

Stoker's wages, 8-hour shifts, 4s. 6d. per shift. One man charges and draws 24 retorts per shift. One man carbonizes 10,320 lbs. coal per shift. One man produces (at 10,800 cubic feet per ton) 49,680 cubic feet of gas per shift.* One man attends to six fires per shift, clinkering the same once every 24 hours. The carbonizing wages per ton, including one man cleaning lids and tidying the retort-house, clinkering and cleaning fires, looking to the water supply of the furnaces, &c., 1s. 6d. per ton—this price being from the time the coal leaves the hoppers until the moment the coke is quenched in the cellar. Each retort carbonizes per diem 1720 lbs. Each retort produces per diem 8316 cubic feet of gas. The life of a retort is 1000 working days on the average, and produces during its life 8,316,000 cubic feet of gas. Each bench requires for fuel, on the average, 9·5 lbs. of coke per 100 lbs. of coal carbonized.

It will be remarked, no doubt, that the retorts are short, being only 11 ft. 6 in. long. Respecting the length of inclined retorts, the writer, together with other Continental engineers, holds very strong views. It is believed that where failures have occurred with the inclined system (and it cannot be denied that failures have happened), it can be traced to the excessive lengths of retorts employed.

To this fact, too, may be traced the falling off in illuminating power, of which so much is heard in England, and which "Field's Analysis" proves.

One of the drawbacks to the inclined system, and, in fact, the most serious one, is the quick accumulation of graphite or "scurf" in the upper ends of the retorts. This accumulation is very marked even in 11 ft. 6 in. lengths, and in highly heated 20-foot retorts it must be a much more serious matter. With short retorts, there is absolutely no falling off in illuminating value, although worked at very high heats. To remove the pressure at the top of long retorts, the remedy has been tried of taking the gas off at the upper ends; but, as might have been anticipated, "the remedy has proved worse than the disease."

Another point in favour of short retorts is that they can be set in one length; the weakness of joints being thus avoided. Setting inclined retorts even in short lengths is a very delicate matter; for the whole setting has an inclination to slide forward. With heavy 20-foot retorts this is very appreciable; and ponderous backstaves and retaining anchors are often employed to keep the retorts in their places. With short lengths, this tendency to slide is reduced to a minimum; and anchors or backstaves are not required.

Again, the cost of the setting and the house for the long retorts is enhanced out of proportion to the labour saved, the gas produced, and the duration of the setting, as compared with the settings of short lengths. This is a controversial matter; but although the writer might, under certain conditions, be tempted to increase the length to 15 feet, no arguments would ever induce him to exceed that length.

Comparing the inclined system with power stoking, the writer argues that everything, including common sense, points in favour of the former plan. Elevators and hoppers are needed in either case; but here the similarity ends. For the inclined system the retort-house may be more cheaply and lightly constructed; and the costly installation of the power stoker, with its power raiser, its skilled labour, and its endless wear and tear, are entirely dispensed with. Power stoking is a costly Colossus, turning an otherwise decent-looking retort-house into something between a pit-head and a machine shop. No! power stoking is an elephantine achievement for the picking up of pins.

Comparing the cost of carbonizing per ton, the writer has no definite information as to the results obtained by the power stoker; but he can scarcely imagine that when everything connected with stoking machinery is taken into consideration, it can work out as cheaply as stoking on the inclined system.

Regarding the cost of installation per mouthpiece, the inclined system is at present handicapped by monopolies and harassing royalties; but once these hindrances are

* If the furnace-cleaner is taken into consideration, the quantity per man per shift equals 33,000 cubic feet.

disposed of, there is no question in the writer's mind that the inclined plan will work out considerably cheaper.

Inclined settings are undoubtedly much more expensive to build than horizontals—perhaps 50 per cent.; but against this must be set off the extremely costly power-stoking machinery. The installation at the Frederiksberg works, including hoppers, elevators, all iron and brickwork, worked out at £103 per retort; and the writer would be glad to know how this compares with first-class stoking machinery.

Personally the writer has nothing but praise for the inclined system, and that it is appreciated by the men is evident from the fact that he has been personally thanked by the Socialist leader of the men's Federation for having lightened their labour. This is very gratifying; and if nothing else has been gained by adopting the plan but a Socialist's thanks, then indeed we hold a proud and enviable position.

Mr. MARSHALL added that they had found dusty coal had a tendency to creep down generally on being heated. If one heated manganese in a closed retort, gas bubbles were formed, and created a little sort of volcano; and he believed something of the same kind happened in inclined retorts. With very fine coal, the upper surface became carbonized quickly from the heat, the gases underneath were compressed to a certain extent, and eventually produced a little volcano in the coal, which caused it to be disturbed, and there was a movement towards the mouthpiece. He did not know of any other reason to account for it; but it was perfectly true that coal did slip down to a certain extent, especially when it was very dusty.

The PRESIDENT said they had had two very interesting papers on the all-absorbing question of retort-setting; and he hoped there would be a good discussion.

Mr. FRANK LIVESEY said one important question raised by Mr. Marshall was the length of the retort. They must admit there was a limit to the length of an inclined retort; and though they would like it longer, there was a limit to getting the coal in. Those who had tried over 20 feet, had not been successful; and some not even with that length. It was evidently easier to charge a retort 11 feet long than one 20 feet. The slipping of the coals had been referred to; and Mr. Carpenter had had some unpleasant experience in this respect. He also had had some experience in the same direction; and he thought the length of the retort came in, and that if the coals were going to slip they would slip more with a long retort than with a short one. In the case of a 20-foot retort, he had known them slip to the extent of 4 feet though they had been put in quite evenly and had remained so for from five to ten minutes. He had actually seen it take place; the top and bottom doors having been left open on purpose, because he thought it possible that the slamming of the doors might cause the slipping. When, however, the doors were left open for about five minutes, the coals gradually slipped down, and the layer, which might have been 8 or 10 inches at the bottom at starting, became considerably thicker. Those who had to deal with Midland coals did not seem to have been at all troubled in this respect; but coals from Durham always slipped. He believed when the inclined retorts were first introduced an angle of 29° or 30° was used; but now, in order to get the coke out better, the angle had been increased even, he had heard, up to 36°. The average seemed to be 32°. Now, he did not think it increased the wages very considerably if a little tickling or poking was required to get the coke out; but it was a much more important matter that the coal should go in as a level charge and remain so. Therefore he thought it would be wise not to overdo the angle of inclination. He agreed with Mr. Marshall that 20 feet was rather too long, though there was a temptation to extend the length, because it cost no more to put in 7 cwt. of coal than 6 cwt. As to stoking machinery, Mr. Marshall suggested that power stoking was an elephantine achievement for the purpose of picking up pins; but if one found an elephant could pick up pins cheaper than any other way, he did not see why he should not do it. If there was plenty of work for a steam stoker to do, and it was efficient, and the men would work it thoroughly, there was not much difference between the carbonizing wages of the machine and inclined retorts, even taking repairs into account. There was still the cost of the setting to be considered, which was about 50 per cent. more for inclined retorts; and this would almost pay for the machine. Nevertheless, for small works where a machine could not be used, the difficulties could not be great, and they must be overcome in some way.

Mr. J. F. BRAIDWOOD (Greenwich) said that he had been working inclined retorts for seven years, doing about half the work with them, or about 1½ million cubic feet a day. There were certainly some difficulties; but they were surmountable. The retorts now working were 15 feet long, set at very varying angles, from 30° to 34°. They put them at three different angles, according to the height from which they dropped the coal, and putting out of sight altogether the discharging; because he considered from the first it was more essential to get the coal to lie evenly for the purpose of carbonizing than to get the coke out automatically, as it required very little more labour just to stir with the poker. The work of carbonizing was done almost entirely by gravitation. There was no elaborate machinery to get out of repair; and in the retort-house there was no danger of a sudden breakdown of machinery. There were all the advantages of the machine, coupled with the security of hand labour. When they first started them, they were not very successful; only bringing the wages down from 2s. 7½d. to 1s. 11d. The next benches brought their wages down to 1s. 8d.; then to 1s. 4½d.; now they had come down to 1s. 2½d.; and he hoped the next would be 10d. He saw no reason why this should not be. He was quite as much in favour of inclined retorts as ever—in fact, rather more so than when he started. Everybody would find some difficulties in commencing; but he would be able to overcome them. They did not know what the meaning of a stopped pipe was, for they had not seen one since they started; and he should be very sorry to get back to horizontal benches.

Mr. S. Y. SHOUBRIDGE (Lower Sydenham) said the author referred to the retorts being set with block stones. He had not heard of any stone in England that would stand such a heat. He should also like to know how he got such a wonderfully low fuel account as an average of 9·5 lbs. of coke used per ton of coal carbonized. He had had some experience of regenerator furnaces, and made a number of tests with the Klonne, and with a setting of nine built for the Birmingham Corporation under a guarantee to work with a fuel account of 12 lbs. per ton. He he was deputed to see that the guarantee was carried out; and, after a week's test in conjunction with Mr. Klonne's representative, working under racing conditions, with all the coke from the ashes picked out and returned to the furnace, they could only just keep it under 12 lbs. Therefore, this 9·5 lbs. represented a distinct advance. With regard to the length of the retorts, he had had some experience with 18 feet ones, and found no difficulty. As to the falling off in illuminating power, it had been said one must go abroad to learn what was going on at home. He certainly had not heard of the illuminating power falling off, or that this had been shown by "Field's Analysis." He should be glad to know how "Field's Analysis" proved that the inclined retort system showed a great falling off in illuminating power. He had worked on inclined retorts by themselves for some time, and had taken careful tests of the illuminating power as well as make, and had found no diminution. In regard to taking off the gas at the top of the retort, he was not aware that this had been done in England with a view to removing the pressure at the top. The difference in level between the bottom and the top, even in a 20-foot retort, at 32°, was only about 10 feet, and therefore the difference in pressure would be quite inconsiderable. With regard to the deposit of carbon, which was said to be a serious matter, he did not find any more saving than with horizontal retorts. The same with the supposed tendency to slide forwards. The retorts were set at the angle of repose; and they would stand perfectly well without any buckstaves or anchors to keep them in place. In fact, at the Middlesbrough Gas-Works 20-foot retorts had worked satisfactorily for many years without any front bracing at all. With regard to the cost of setting, the author stated, and Mr. Livesey supported him, that the inclined settings were more expensive to build, perhaps by 50 per cent. He had taken a careful account of this matter, and found it more expensive to build horizontal retorts than inclined ones, taking the whole cost under the same conditions with regenerator furnaces and discharging stages. Of course, he was not comparing them with a horizontal bench on the ground floor. He could not agree with Mr. Marshall in his humorous remarks with regard to stoking machinery.

It was not beautiful; but it was very useful and ingenious, and the cost of work was practically the same as with the inclined retorts. There was a considerable field for both; and seeing that machinery had done so much for them in the past, he thought it somewhat ungracious to speak of it as Mr. Marshall did. He had been much struck with the figures given for the handling of the coal, and congratulated the author on the exceedingly good results obtained. He should hope to have the opportunity of seeing the works mentioned. With regard to Mr. Drory's paper, he was astonished to hear what great savings he had effected, which was more than in England—viz., 1s. 8d. per ton—and he also said he had economized nearly the same amount in fuel. He presumed this was not from the inclined retorts, but from the regenerator furnace, which might equally be applied to horizontal retorts. He had not found creeping taking place with Lancashire coal. He had tried coal of all sizes, and watched the results most carefully. He imagined it must be due to Northumberland coal particularly. The angle at which the retort was set must affect the result; but with 32°, he should hardly have expected it, even with fine coal. However, Mr. Livesey's experiments proved that it did; and this was one of the difficulties which would have to be overcome. He did not think it insuperable.

Mr. C. C. CARPENTER (Vauxhall) said the matter most prominently brought forward by Mr. Woodall in connection with inclined retorts was a very serious one. An installation was put up at Bankside; and if it were assumed that one of the conditions of proper carbonizing was to maintain a level layer of coal from one end of the retort to the other during the process, then the retorts as they had them set were incapable of dealing with half the kinds of coal they obtained from Durham and Northumberland. Only one half would, when put in in an even layer, stop during the carbonizing; the other half slipped down to a greater or less degree. With many of them, in two or three minutes after charging, the bottom of the retort was full to the crown with coal, while the upper part was empty to the extent of 5 or 6 feet. This was a serious matter. What they had to do was not to shoot in coal at one end of the retort, and get coke out at the other, but to efficiently carbonize it, and get the maximum value from the coal handled. At the present time, they were not able to do this at Bankside with retorts 20 feet in length at an angle of 32°. Then the carbon question was a very curious one. The retorts would not run longer than three weeks without scurfing; by that time it was necessary, in order to get the coal to run in and the coke to run out, to scurf them. This experience was confirmed by Mr. Marshall, even in his 11 ft. 6 in. retorts; and if the carbon was there on the retort, where did it come from? It must be gas that should have gone up the ascension-pipe, which had given up its carbon and remained on the crown of the retort, instead of going up the ascension-pipe to be measured at the meter. He was interested to note the emphatic way in which Mr. Marshall stated that 11 ft. 6 in. was the proper length. It appeared that he might extend it possibly to 15 feet, but no farther. They might assume, therefore, that the ideal conditions were to have retorts 11 ft. 6 in.; and if this were so, and if they could only get carbonizing conditions as good as they obtained now, it was a very serious factor. In days gone by, a great deal was made of the fact that a large increase in retort capacity was effected with inclined retorts; but if they had to cut them down to 11 ft. 6 in., a lot of this advantage would be gone. Other people had experienced the difficulty with the coal creeping, and Mr. Drory laid particular stress upon it in his paper, and pointed out that as the kind of coal varied so they had to alter the damper and send more fuel to the top or to the bottom to burn off the coal. Carbonizing plant of this description was, in his opinion, very far from being an automatic one. Mr. Marshall spoke about machinery, which he seemed to look at with horror; and he (Mr. Carpenter) thought he hardly took a fair view of it. At Vauxhall they had two kinds of stoking machinery; the most efficient being an Arrol-Foulis, which they were operating in a large house of 200 retorts. They were provided with elevators, each charging-machine having its elevator, which took up the coal from the floor of the house according to the requirements of the works. The supply of coal to the machine was part and parcel of the construction. They might merely dump the coal down in a barrow at the rear of the machine; and it would pick it up and deliver it in an even layer into the retorts. He had taken out the cost of carbonizing in the same way as Mr. Marshall—the stokers' wages at 4s. 6d. a shift, working three-hour shifts—and he added the cost of clinkering the furnace and quenching the coke, the men being employed at the same rate as Mr. Marshall. He found the cost of carbonizing came, under these circumstances, to 10·11d. per ton, as compared with Mr. Marshall's 1s. 6d. per ton. If he could carbonize by machinery at a little over 10d., why should he put down plant which would do it under precisely the same conditions at 1s. 6d.?

Mr. MARSHALL asked if Mr. Carpenter included wear and tear and maintenance of the machinery.

Mr. CARPENTER replied that he did not; he had taken the figures just as Mr. Marshall had given them, and not including any wear and tear.

Mr. MARSHALL said there was not any wear and tear with the inclined retorts; there was no machinery.

Mr. CARPENTER said there was the money spent on the inclined retorts in the first instance, which would go against the wear and tear of machinery. But even adding something for wear and tear, there was a great difference between 10d. and 1s. 6d. Mr. Marshall spoke of the elephantine picking up of pins; but a self-contained charging-machine which would pick up coal from the floor and put it into the retorts in a regular even layer, which only weighed 12 tons, and which would deal with 140 tons in 24 hours, he did not think was of an unreasonable weight. With regard to the cost, the charging and drawing machinery, boilers, and everything for the 200 retorts, came to less than £4000, or £20 per 20-foot retort; so that if they took the cost of erecting 20-foot retorts at £52 per retort, which they could do them for, and added £20 for the cost of the machinery, this only made £72, and they could have retorts 20 feet long for considerably less cost than those Mr. Marshall advocated, which were a little more than half the length. These 20-foot retorts would carbonize in 24 hours 3136 tons of coal, as against Mr. Marshall's 1720 tons, the cost of which was £103 per retort.

The PRESIDENT asked Mr. Carpenter if he included in the 10·11d. the removal of the coke.

Mr. CARPENTER said he endeavoured to base his comparison on Mr. Marshall's figures. He included quenching the coke but not its removal.

Mr. C. HUNT (Birmingham) said he was disposed to agree with Mr. Carpenter, that if the case for inclined retorts had to rest on Mr. Marshall's paper, it was not very strong. He was much surprised at the figure Mr. Marshall gave as the cost of working the inclined retort system with his low rate of wages. He (Mr. Hunt) had not gone into the cost of machine charging with the same care as Mr. Carpenter had; but week by week their carbonizing expenses with the use of machinery amounted to only a fraction more than the figure Mr. Marshall had mentioned, and the total included many items which Mr. Marshall had not mentioned—the foremen, and all the incidental expenses of the retort-house. He should therefore be very reluctant to adopt the inclined system, if he were not fairly assured that the figure for carbonizing could be brought down lower than it was put at. He did not propose to enter into a controversy as to the length of retorts. He had had some experience on the point, and felt confident that if the system was worth anything, it was as good for a long retort as for a short one. Opinion was, however, divided on the subject; and they could only wait until it was further worked out. Mr. Marshall's arrangement appeared to be a most complete one, and acted almost, if not quite, automatically; and naturally one compared it with the ordinary English mode of working. It appeared that Mr. Marshall brought his coal to the coal-breaker, elevated it to the store, dropped it on to a conveyor, and elevated it again to the 51 retorts; so that he had four elevators and two conveyors. Every ton of coal thus had to be lifted twice in order that the small quantity which was taken from the store might be dealt with automatically. The ordinary English method was to bring the coal to the breaker as it arrived, and elevate it straight into the hopper; and only the quantity taken from the store had to be dealt with twice. Assuming that out of the 30,000 tons of coal a year 1000 tons were stored, it followed that the cost of taking up this coal and bringing it to the breaker would be about 6d. a ton. If they saved the 6d., and elevated 29,000 tons at a cost of ¼d. to ½d. a ton, it was easy to work out and ascertain which way

the advantage lay. He failed to see any advantage in doing work twice over, if it was done at a greater cost; and he also failed to see that it was inevitable. If it were, it was rather fatal to it. But he was inclined to think that, if Mr. Marshall had worked out his scheme a little more, he would have avoided what appeared to him (Mr. Hunt) to be a defect. He should like to know if the De Brouwer conveyor mentioned in Mr. Drory's paper was used anywhere with inclined retorts, or whether it was simply an idea that it was suitable for the purpose. It appeared to him that the use of conveyors with inclined retorts was a somewhat different problem to that of their use with horizontal ones. With the latter, the quantity of coke to be dealt with was much smaller, and came out more gently; whereas in all the successful inclined retorts he had seen, it came out with a rush, and the conveyor must be specially constructed in order to cope with it properly.

Mr. R. Brown (Cambridge) said, with reference to Mr. Drory's paper, he was surprised that the author relied on the intelligence of the workmen for the amount of coal put into the retorts. He looked upon the success of the system as being due to the fact that the charges were under the direct control of the foreman; and when once they were set, the workman had only to pull a lever. He thought Mr. Drory's measuring chambers could not be of the latest type. With regard to the length of the retorts, he was going in for 20-foot ones; but after listening to Mr. Carpenter's experience, he was inclined to be a little nervous. Still, he was quite confident that he should have no difficulty with South Yorkshire (Silkstone) coal.

Mr. Carpenter said there was not so much difficulty with Silkstone as with Newcastle and Durham coal.

Mr. J. West (Manchester) said it was hardly necessary for him now to advocate stoking machinery, as he did formerly, as there were so many who had used it who could speak for themselves. Mr. Drory had told them what he saved in wages; but this was of no use to Englishmen, because they did not know what it cost him on the old system, and he did not say what it now cost him on the new. Mr. Marshall gave exactly what it cost him up to a certain point—the 1s. 6d.; but on reading the paper he (Mr. West) fancied it did not include getting in the coal or removing the coke, and several other matters. Neither did it mention any interest. If these items could be separately given, and if it represented an increased cost for inclined over horizontal retorts, it would be interesting, because it appeared that the two methods of carbonizing coal had now both to rely upon machinery to some extent; and the cost should be very carefully given in detail. He was pleased to find that some figures had now been furnished. The best, as to stoking machinery, were those brought forward by Mr. Tysoe, where he gave the cost from the taking of the coal from the store to the delivery of the coke into the yard—all in detail. There might be an advantage in one works over another; but, if it could be taken in this way, it would prevent a great deal of difficulty in finding out the real cost of carbonizing. Mr. Tysoe gave the average cost of the different kinds of stoking machinery as 1s. 5d. per ton, including all these charges. The wear and tear was, of course, an item for consideration in connection with the inclined retorts, which he did not think had been given. The cost of elevating and conveying applied to one system as well as to the other. He had seen Mr. Marshall's admirable works, and looked upon them as a model. He there had an opportunity of displaying his talents, and erecting completely new works, which he had done in a very admirable manner. The elevating and conveying machinery he (Mr. West) had had the privilege of making under Mr. Marshall's direction; and no doubt it worked well. His only objection to it was that it was a new thing; and though he had his own price for it, it did not pay him. In Mr. Drory's paper, he was much struck by the question of ventilation. This applied both to the horizontal and the inclined systems, but more to the latter. From the humanitarian point of view, he could not imagine why people should advocate the inclined system so much as they did. A great deal might be done to secure ventilation. The system he adopted was to leave at the back of the retort-house a cavity of 6 inches; and when the coke was thrown down into the vaults, he found the steam did not come down as it did formerly where there was no ventilation, but flowed up under the arch and gradually crept away. He was recently down at the President's works, looking at some inclined retorts he was putting up, where he had made provision for ventilation in the same way. He was also arranging, in connection with the inclined retort installation, a conveying plant which no doubt had a great deal to do with the economy of the system, and getting the whole coal delivered and the coke brought away by the aid of machinery. He did not allow the coke to go down to the vault, but drew it along the front of the retorts in a long, wide trough; and he believed in this way as much economy as could be produced by machinery would be achieved. What Mr. Marshall had said about colossal structures, he took to be merely a figure of speech. He believed in the survival of the fittest. It was immaterial to him which went to the front—inclined retorts or stoking machinery—as he could make something out of either; but he had no doubt Mr. Marshall's arrangement was very good. While on the Continent, he was very much impressed by finding that all who were using inclined retorts were impressed with the idea that they must be short—not more than 15 feet, while some were using 12-foot, and talked about 11-foot retorts. He was not quite certain that he was not with them, having seen something of the work of the longer ones. But he did not wish to give a decided opinion, though he thought it doubtful whether the smaller retort did not carbonize better. It was one of the things which those having large works could test. The great stumbling-block to be got over was the one which Mr. Carpenter had mentioned, and which he observed himself twenty years ago, when he first made experiments with Mr. Carpenter at Sheerness. They found that, however nicely they planted the coal in, it did at a certain temperature begin to slide; and this was the chief reason why the plan was then given up. He did not think it would apply so much to the Midland as to the Lancashire and Newcastle coal. He had never seen it occur at Salford, as it did with Newcastle coal. He was rather inclined to stick to the old system of horizontal retorts, which he looked upon as a positive system, because the coals remained in the place where they were put. The other he called the speculative system; and he did not think it had been proved that any substantial gain had been achieved by it. There was another point not yet cleared up; and that was as to the illuminating power. He wanted to be convinced that one got the same units of light out of a given quantity of coal by the inclined system as by the horizontal. The paper stated that it was the same; but it could hardly be said to have been strictly proved, and it did not quite agree with what Mr. Carpenter had remarked about the carbon. He might suggest that a Committee of the Institution should be appointed to investigate the question.

Mr. W. R. Herring (Edinburgh) said he was an advocate of the inclined retort system, and was quite satisfied it could be made a success. But there were local conditions to be considered, which might present little difficulties that would have to be overcome. They had heard a good deal about the coal slipping forward; and he would like to ask Mr. Carpenter whether he had tried mixing the coal. He admitted that one-half of what they used had this tendency; and he should like to know if he had experimented with using a certain percentage of the other half which did not slide. It was quite possible that the Durham coal had a great tendency to become a fluid mass in carbonizing, and that the process of fluxing gave a tendency to creep, in the same way as lead laid on a sloping roof would gradually creep down to the eaves. Probably by mixing the coal the difficulty would be overcome. With regard to the question of relative cost, it was very difficult to get any information from such a discussion. In the first place, the whole question was what would be the relative difference in one's own works, because there were no two works alike. The labour conditions were quite different. At one works it was possible to get half as much again out of the workmen as in others, where they would not stand any extra work at all. When he was at Huddersfield, he knew that he should be stirring up a hornet's nest if he tried to impose any additional labour on the stokers; so he was very careful to begin cautiously. For some time before the inclined retorts were started, he had a careful note made of the actual duration of the physical labour of the stokers at ordinary work; and he adjusted the work on the inclined retorts so as to come to about that—setting the men to work with a margin of about 10 or 15 per cent. on his own side, so as to allow a little bit to knock off. Ultimately they settled down to the same

period of time as before, and effected a saving of 1s. 3d. a ton on the carbonizing wages, which they could have saved by no other means. That was the measure of advantage to themselves. Where he was now they had machinery, and did not save more than ¾d. per 1000 cubic feet, because the advantage of working by machinery, as compared with hand-charging works, was only where the men worked under similar conditions. This showed the difficulty of making statements as to cost. Those who had inclined retorts could say what they saved as compared with their former system; and these, in his opinion, were the only reliable figures. He could quote gas-works where shovel charging, even at the present day, would knock either machinery or inclined retorts into a "cocked hat," simply because the men were satisfied to do much more work. They worked twelve-hour shifts, and had other considerations from the company. With regard to Mr. Marshall's paper, he must say that at the time he read the paper on coal-stores, he could not quite see the necessity of the system. He did not believe in putting coal into stock one week, and taking it out the next. He thought it better to put down stock for an emergency, and leave it there. He believed Mr. Marshall could well have kept his reserve stock, and carried the whole of the coal up practically with one elevator. He put it into an overhead hopper. This was also done in England in many cases; but he had to transfer it from the hopper into a traversing shoot, and then to travel the coal along again. He did not believe in this system; it was not scientific. Once one started mechanically manipulating coal, it ought to be brought to the exact position it was wanted in, instead of into a large hopper like the one described. He should have converted it into a continuous trough right along the shoot, which would have cost practically the same, and would have saved the men's time, and consequently money. With regard to ventilation, his new house at Huddersfield was built purposely for inclined retorts; and he had no trouble in this respect. There was a space of about 1 ft. 9 in. in front of the drawing side of the retort between the brickwork and the stage; and in the wall outside there were several large openings communicating with the yards. In front of the retorts was a traversing screen, against which the coke abutted when it fell out of the retorts. A current of air was drawn in under the stage through the openings; it passed up this space in front of the stage, and carried all the steam and smoke clear up into the roof, without revolving round the heads of the workmen. As to the length of the retorts, this was a question of peculiar interest now. He so far thought the inclined retort system was best, that he advised his Commissioners to put down nothing else at the new works; but he was debating whether he should go in for 15-feet or 20-feet retorts. He had had somewhat large experience of 15 feet ones, but, as it had been remarked, one was very much tempted to go in for longer ones, as they were charged with the same physical labour, so that there would be considerable saving in cost. With this view, he had been to inspect several installations at work in this country, and could see no reason why 20-feet retorts should not be adopted. There were works where they had been in use for some four or five years; and why Mr. Marshall refused to go beyond 15 feet, he did not know. There was perhaps something in the question of the fall of illuminating power; but a gentleman who had 20-feet retorts wrote to him some time ago saying he had been working them for two years, and suddenly found depreciation in the illuminating power, and asked if he found the same result. He wrote back and pointed out that the fact of working two years without any difficulty surely indicated a defect somewhere else rather than in the system; and ultimately he found some joints in the vacuum chamber had sprung, and he had been drawing in a little air. This was in the case of a town where the testings were carried on very rigidly; the Company and the Corporation being rather antagonistic. With regard to carbon accumulating, of course, it must have come from the gas; but it was quite evident there must have been far more pressure in the retorts than was necessary. They found the same thing with horizontal retorts, if they had a high pressure and did not relieve it; but if they ran with a very light seal, and kept the exhauster well going, the accumulation of carbon was practically no more than with a horizontal setting. He maintained it could be regulated by the running of the exhauster rather than anything else. With regard to the various methods of charging, in his opinion it was necessary to have the measuring chamber so arranged that, whatever weight of coal was to be discharged into the retort, it must pass the mouth of the shoot in the same period of time, or one did not get a level charge. If it took two seconds to charge a 15-feet retort with 4 cwt., and it was intended to increase it to 5 cwt., this 5 cwt. must be discharged equally quickly from the chamber, or a good uniform layer was not obtained. To do this, they introduced a slide-valve into the bottom of the measuring chamber; and when they wanted to adjust the weights, they adjusted the valve. This proved very successful indeed. He had had no trouble with the creeping of coal.

The PRESIDENT said they had had a most interesting discussion, which should be very useful, especially as it had elicited the opinion of a number of gentlemen who had worked with inclined retorts, and who knew something of both the advantages and drawbacks. These advantages and drawbacks had been set against those of stoking machinery; but they were not yet in a position to draw any decided conclusions as to the relative merits of the two systems. He felt himself very much in sympathy with Mr. Herring's remarks. It was difficult, if not impossible, to make comparisons between the expenses at one works and those at another, in a different part of the world and under different conditions. The only way to settle the question definitely whether the inclined retort or the horizontal when drawn by machinery was most economical in the matter of wages, would be for one works to have two retort-houses fitted up with the same number of retorts—one on one system, and the other on the other—using the same materials, and comparing them under the same conditions. A good deal had been said about 20-feet retorts; and it was stated that there were gentlemen who had had them in use, and found the illuminating power not so good as was anticipated. He did not know them, however, and their names had not been mentioned; and he did not quite see how the reduction in illuminating power was to come in. In Manchester, they had worked for some years 15-feet retorts, which were half as long again as the old 10-feet ones. The gas from the 10-feet retort had to go up one pipe, and the same with the gas from the 15-feet retort. There was 50 per cent. added to the length; but he never heard of any reduction in the illuminating power due to this fact, nor did he see why there should be if one put on another third and made it 20 feet. Arguing on these lines, he had come to the conclusion that he might venture to put down retorts 20 feet long. But as he had not yet worked them, he could not say whether he had done right or not. With regard to carbon, his own experience was that there was so much variety in the quantity of carbon deposited in horizontal retorts—in some cases so little and in others so much—that he did not think any unusual quantity could be put down either to the inclined system or to the length. He was quite sure the greatest advantage to be obtained from the inclined system (if it were to be secured at all), was by performing these mechanical operations once and for all. He did not believe in lifting coal twice if it could be avoided, or in moving a series of scoops about the house for the purpose of conveying coal from a large hopper to the retorts. He had endeavoured to put up such an installation that when the coal tumbled out of the truck, it would find its way by mechanical appliances alone exactly opposite the retort into which it had to be put, and that there should be nothing for a man to do but to pull a lever and let the coal drop into the retort; and when the coal was carbonized, the man at the bottom should open the door, and the coke come out. He hoped it would come out of its own accord; and then it would be removed, also entirely by mechanical means. The question of slipping, he believed to depend a great deal on the suitable angle of the retort for the particular coal used. Of course, they could not set retorts for every kind of coal, or always use the same coal; and therefore they must try to hit upon the happy medium. If it were a little too flat for some coal, the coke might require a little tickling to come out; but on the other side it might be perhaps too steep for those extreme coals which ran like treacle. They were, however, not likely to be troubled in this way in Lancashire. The chief difficulty they had was the swelling property of the coal, so that they could not put in large charges or the whole retort filled up, and it was very difficult to get it out afterwards. He would now call on Mr. Woodall to reply on behalf of Mr. Drory.

Mr. WOODALL said unfortunately he had not been able to hear all the discussion. Happily they had been eliminating the questions which hampered their position with regard to inclined retorts from year to year. All questions as to the construction, durability, and so forth, were now relegated to the limbo from which they would not return; and the remaining questions were rather those of first cost and incidental charges for interest and working expenses, as compared with horizontal retorts, whether hand worked or by machinery. That the system, as a system, would work perfectly satisfactorily, there was now abundant evidence. He regretted that Mr. Drory, in his paper, attached so much weight to the difference of conditions of Continental work as not to give the actual figures of his own works prior to the introduction of the inclined retorts and since, because he agreed with the observation of Mr. West that it would be useful to have the comparison of the cost to him under his own circumstances with his own system. He also agreed with Mr. Herring that throughout the country there would be special conditions attaching to special installations which would always make the figures of individual works of value to an Institution like this. They never need be afraid of multiplying statistics, for fear of a plethora of knowledge. He understood that Mr. Hunt had asked if the De Brouwer conveyor was at work at Berlin. At present it was not; and consequently the good results anticipated from its operation had still to be realized. With regard to furnaces, he did not think there was very much to be said *qua* inclined retorts. A good system of regenerative firing would be equally economical, whether applied to inclined or horizontal retorts. With regard to creeping, he could not say whether there was any at Berlin. He believed there was a little, but slight in comparison with that which was found with some Durham coals. As to Mr. Marshall's paper, he wanted to ask what was intended to be shown by the table of costs. There was a statement there, reduced to the smallest possible denomination, of the men employed in the working of an installation, the expenditure on oil, waste, sundries, and charges for depreciation and interest; but if this was intended to compare with the accounts of a company working horizontal retorts, a depreciation of some 2 per cent. he must take exception to. Unless there was the usual abundant provision for repair and maintenance and keeping the apparatus in perfect order out of revenue, 2 per cent. was a negligeable quantity. The 4 per cent. for interest, also, was a figure which, while it would cover the actual cost of raising the money, was not sufficient to compare with the interest paid by a gas company on the capital invested in their retort-houses. He presumed the charge of £103 per mouthpiece was for the bench only, and that it did not cover the retort-house.

Mr. MARSHALL said he was aware this was a controversial paper, and that it was an *ex parte* statement; but it was the result of many years' experience. He had simply given the facts. Mr. Hunt had said he deprecated the system he had adopted, and that he ought to have given more thought to it. If Mr. Hunt had known the hours he had taken over it, the works he had visited, and the hundreds of miles he had travelled, he never would have made such an observation. Every detail, every bolt and nut put into the installation, had been the result of years of thought and careful experiment. There was not a pound of weight that had not been estimated beforehand. Whether he should put up a square hopper, a long hopper, a continuous elevator, or a short elevator, had all been questions of careful calculation as to what they could save; and he believed if Mr. Hunt would come and see the works, he would withdraw his remark about not having taken time to think out the details. With regard to the rate of wages, it was not cheap; but then he had Unionists and Socialists to deal with. He had made a bargain with his men. They served him faithfully, and gave him a good solid day's work; and he was perfectly willing to give them a good solid day's pay. Therefore, though his wages were 1s. 6d., against Mr. Braidwood's 1s. 2d., he could not do better. He hoped his Directors would be satisfied with the 1s. 6d. At any rate, he was, and the men were. Why he disliked machinery was that it was complicated, and required a different class of men to work it. This was a case of Columbus and the egg; it was simply elevating the coal, and dropping it in. Why should one use a great amount of machinery, requiring men of special knowledge, and incur great expense for wear and tear, and oil and so on, when the same results could be obtained by such a simple process? When the works were designed, one of his Directors wrote to him and asked if he had really made up his mind to have inclined retorts, and if he had given the matter all the consideration necessary. He could only write back and say that he had. It seemed so simple in every possible way; and after years of experiment, he did not think he could do better than ask them to adopt it. It was an expensive setting, for the reason he had told them. They had heavy royalties to pay; but when the patents lapsed, inclined retorts could be put up just as cheaply as horizontal ones. With regard to elevating the coal twice, this was owing to the situation of the works. They were cut off sometimes for a week from the harbour, and could not store coal on the works themselves because the Railway Company could never give them the disposal of sufficient trucks to empty a ship at the rate of 400 or 500 tons a day. By their new unloading machinery, they could empty as much as they liked into the stores at the harbour. Then from there they had to take up what they wanted to supply the works. He must always have on the works a week's supply, because he might be cut off from the harbour for ten or twelve days in the winter. He therefore had to have a small intermediate store, in order to keep a week's supply in reserve. It had to be put down somewhere on the ground or into the hoppers at once. What would be the cost of the structure if he had to store 1000 tons at the height of the retort-bench? Considering the ironwork and brickwork which he would have to employ for the simple process of having to put coal in by one elevator, it was much cheaper in their circumstances to make two bites at the cherry than to store the coals overhead. He was fully alive to the fact that he was elevating the coal twice; but on going into the figures, he found no other way of doing it. He thought they had adopted the cheapest plan in the long run. Assuming it was an expensive apparatus, they had done away with men's labour. He only had two men to work the entire coal arrangements; and less than two there could not be under any conditions. Mr. Braidwood said he hoped to bring his cost at the works down to 10d. per ton. He was sorry to say he had no hopes of coming down in wages, but rather expected he should have to go up. With regard to the length of the retorts and the falling off in illuminating power, his experience was that, if anything, there was a slight gain. He could only say that Mr. Woodall was his authority for the statement that "Field's Analysis" stated that in England there had been indications observed which were believed to be due to the extreme length of inclined retorts, and that it was the marked deposition of carbon which caused it. There was no doubt that on opening the lid one saw the carbon hanging down like stalactites of soot; and if this was allowed to remain for the next charge, the soot stalactite became harder, and in time one had a great cake of carbon. But perhaps, on the average, not more came out of the gas, because at the lower end the carbon was the finest possible scale; and he doubted whether there was really more on the whole than in a horizontal retort. Certainly they did get at the upper ends very marked deposits, which must result in a loss of illuminating power. If there had been failures in England, he could only suggest that the retorts had been too long. A 20-foot retort was expensive to set. There were three joints in it; and having the joints properly made, and getting it properly aligned, was a most difficult thing. With short retorts, one just popped them in; and as long as the bricks on which they rested were firm, there was no difficulty whatever. In this respect, he thought the wear and tear was much less than with long retorts. The life of the retort was longer, and the heating surface was better. In the case of long retorts, one was decomposing the gas in the last 4 feet at the top, not getting it into the gasholder. This was, of course, only his opinion; but it was based on observation. There was no doubt it was an expensive thing to build an inclined setting. There was at least 30 to 40 per cent. more brickwork in it; the height was greater; and the labour was more. With regard to the creeping of coal, he often thought that there was more tendency for this with the glazed retorts which were in almost universal use on the Continent. Whether they had any advantages or not, he was not sure; but there was certainly the disadvantage that when they were scurfed the first time it took off the glaze, and it sometimes brought a piece of the retort away with it. For this reason he was

strongly of opinion that it would be better not to use glazed retorts. With very fine, dusty coal there was a great tendency to creep. He had found it over and over again; and they had had much trouble with one of their coal contractors on account of his sending the coal in very fine and dusty—so much so, that they could only use it by giving it a good dose of water before putting it into the retorts. Mr. Shoubridge asked how he managed to keep down his fuel account so low. He could only say that his was a very splendid generator. The returns were only 9½ to 10 lbs. of coke per 100 lbs. of coal carbonized. No doubt, Mr. Carpenter had made out a very strong case for the mechanical stoker, and perhaps the wages per ton were less; but he did not think he had done the inclined system full justice, nor had he put on to the mechanical stoker all that was due to it in the way of wear and tear, oil, and suchlike incidental matters. Certainly as long as there was no wear and tear, the mechanical stoker could do the work as cheaply as inclined retorts. He had had a mechanical stoker; but after some time he determined it should be the last. He would, however, have inclined retorts next time. Mr. West asked what the coke cost into the yard. It cost exactly 1s. 9d. from the time the coal left the yard till the coke was stacked in it. Mr. Herring had remarked on the fact that this system lightened labour; and this was really the *crux* of the whole position. It was not what they could get out of the men, but if they could do anything to reduce the labour of the men they ought to. For this reason, he had done all he could to adopt the system, because there was no question that men's labour was reduced to a minimum. He should not have been in the proud position of being thanked by a Socialist leader if it had not been so.

THE ACETYLENE EXHIBITION AT THE IMPERIAL INSTITUTE, SOUTH KENSINGTON.

The formal opening of this exhibition took place on Wednesday last, in the East Conference Hall of the Institute. The inaugural address was delivered by Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I., Chairman of the Council of the Society of Arts. He was supported on the platform by Sir Frederick Abel, Bart., K.C.B., D.C.L., D.Sc., F.R.S.; Captain Sir Alfred Jephson; Sir Henry Trueman Wood, M.A.; Mr. H. E. Jones, M.Inst.C.E.; Mr. Boverton Redwood, F.R.S.E.; and others.

Sir Owen Tudor Burne commenced by briefly recapitulating the more important facts in the history of the acetylene industry, and the aim of the exhibition. The advances in the construction of apparatus for the production of acetylene, and a desire to safeguard the interests of inventors and of the public, who had taken alarm at the reports of accidents due to the improper handling of the gas, had impelled the authorities of the Imperial Institute to make arrangements for holding an exhibition by which the safety and advantages of the new illuminant might be demonstrated. The Council of the Society of Arts having been approached, they had consented to form a Committee of experts, who had laid down rules for the admission of apparatus to the exhibition (*ante*, p. 953). This Committee had been at work for some time past examining and testing the safety of the various appliances submitted to them. The tests had been carried out at the Weights and Measures Office of the London County Council, who had kindly placed space at the disposal of the Committee. Professor Vivian B. Lewes (who was unfortunately absent from the opening ceremony) and Mr. Boverton Redwood had directly supervised the tests, which had been made by Mr. Duffield. The same gentlemen had undertaken to watch the working of the apparatus at the exhibition; and their observations would be embodied subsequently in a report, which would be issued by the authorities.

Sir Owen Tudor Burne then formally declared the exhibition open; and after a vote of thanks to him for his services had been cordially passed, the party present at the ceremony viewed the exhibits and the illumination of the Intermediate Ground-Floor Gallery of the Institute by means of acetylene. The 7-light gaseliers fitted in this gallery are supplied with acetylene from generators placed in a shed in the adjacent South-West Quadrangle. Each exhibitor has one generator at work in this quadrangle, and supplies therefrom at least one gaselier in the gallery. The choice of burners and globes has been left to the individual tastes of the exhibitors. The "Naphey" burner, or a modification of it, has been almost universally used. Naked flames are quite common, though several varieties of ornamental globes are used on some gaseliers. Small "Holophane" globes, in our opinion, give the most pleasing effect. The calcium carbide used by the exhibitors is supplied by the Acetylene Illuminating Company.

There are 26 exhibits of generating apparatus not at work in the North Gallery of the Institute; and duplicates of all the generators which supply gas for the illumination of the Intermediate Gallery may here be seen, and the methods in which they act examined. We purpose giving a detailed account of the exhibits in an early issue. In the meantime, we may say that the exhibition is well worth a visit by everyone who is interested in artificial lighting. All the exhibits appeared to be in place on the opening day; and the illumination of the Intermediate Gallery passed off without hitch.

Connected with the subject of acetylene, it may be mentioned that we have just received a copy of a *brochure* entitled "Acetylene Gas, its Nature, Properties, and Uses; also Calcium Carbide, its Composition, Properties, and Method of Manufacture," by G. F. Thompson. We are told in the preface that the work originated in a lecture delivered by the author before the Liverpool Polytechnic Society. We are thus not surprised to find that it is of that semi-popular character which is acceptable to those who hope to acquire scientific knowledge with the least possible tax on their powers of learning. To the technical man, the work will be almost useless; for it has many inaccuracies and omits important and relevant facts. We are told that acetylene "is practically free from phosphuretted hydrogen, with which coal gas is always more or less contaminated." We wonder if the words "acetylene" and "coal gas" have become accidentally transposed in the sentence quoted. If they have not, the statement is misleading in a manner which is quite unpardonable. The same remark must be made as to the author's statement about the comparative cost of lighting by acetylene and by coal gas. Carbide costs *wholesale* £20 per ton; and 1 lb. of it yields 5 cubic feet of acetylene. A cubic foot of acetylene burnt in any burner which will retain its efficiency for a moderate period, will not give an illuminating value of more than 40 candles per hour. At these figures, acetylene gives 1000 candle-hours at a cost of 10·7d. An incandescent gas-burner gives an efficiency of at least 12½ candles per cubic foot per hour; and with coal gas at 2s. 9d. per 1000 cubic feet, 1000 candle-hours cost 2·64d. This is less than a quarter of the cost of 1000 candle-hours from acetylene. Mr. Thompson, however, taking carbide and coal gas at the above prices, finds that lighting by the Welsbach burner (exclusive of mantle renewals) costs more than half as much as lighting by acetylene. He does not explain the method of calculation by which his comparative costs of lighting are obtained; and a casual reader of his book might regard them as correct and be prejudiced unjustly against coal gas. We could multiply examples of this kind, were it worth while; but the above show that the book is a very unsafe one to place in the hands of any person who wishes to have a fair unvarnished statement of the merits of acetylene. Acetylene does not need such dubious support as this work offers it.

The Liquefaction of Hydrogen by Dewar.—Further particulars have been published in a recent number of "Nature" as to the achievement of Professor Dewar in liquefying on the 10th ult. both hydrogen and helium. Preparations for the operation had been going on for some time previous to this date; and considerable expense had been incurred in dealing with the very grave incidental difficulties. The conditions of the experiment give some idea of the nature and gravity of these difficulties. Hydrogen cooled to −205° C. escaped, under a pressure of 180 atmospheres, into a vacuum vessel surrounded by a space which was itself maintained at a temperature of −200° C. Thus constrained, it liquefied, and about 20 c.c. of the liquid were collected in another vessel. The fluid is described as transparent, colourless, with a well-defined meniscus, and apparently with a relatively high refractive index. The hope is expressed that this great success will not be marred by any controversy on the point of priority; but the sound of conflicting claims in this regard has already been heard. The writer in "Nature" remarks that the time is long past when the liquefaction of a gas was interesting, as proving that, under proper conditions, all substances of the kind can be liquefied. The importance of an operation of this order is now in the use to which the result can be put in revealing some properties of the substance, or of other substances. In the case of the liquefaction of hydrogen, there was no discovery of principle to be effected by way of necessary preliminary. The difficulties of the experiment lay not in the understanding of the principles, but in applying them. In a communication to the French Academy, M. Moissan, while recalling the inconclusive experiments of Cailletet and Wroblewski, admitted the claim of the work of Professor Dewar to rank as "a wonder of modern chemistry." The apparatus used in this experiment was made by Messrs. Lennox, Reynolds, and Fyfe, and took a year to build up; while testing and the trial runs occupied many months. All known gases have now been condensed into liquids which can be manipulated at their boiling-points under atmospheric pressure in suitably arranged vacuum vessels. With hydrogen as a cooling agent, we shall get within 20° or 30° of the zero of absolute temperature, and its use will open up an entirely new field of scientific inquiry. No one, remarks Professor Dewar, can predict the properties of matter near the zero of temperature.

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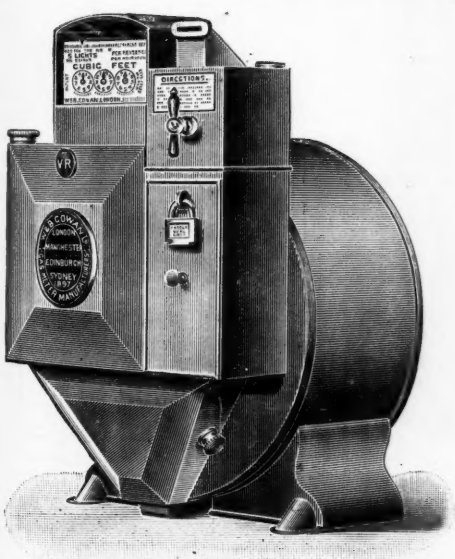

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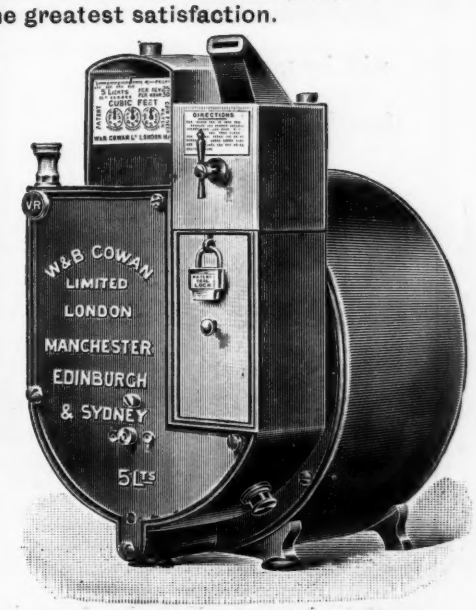

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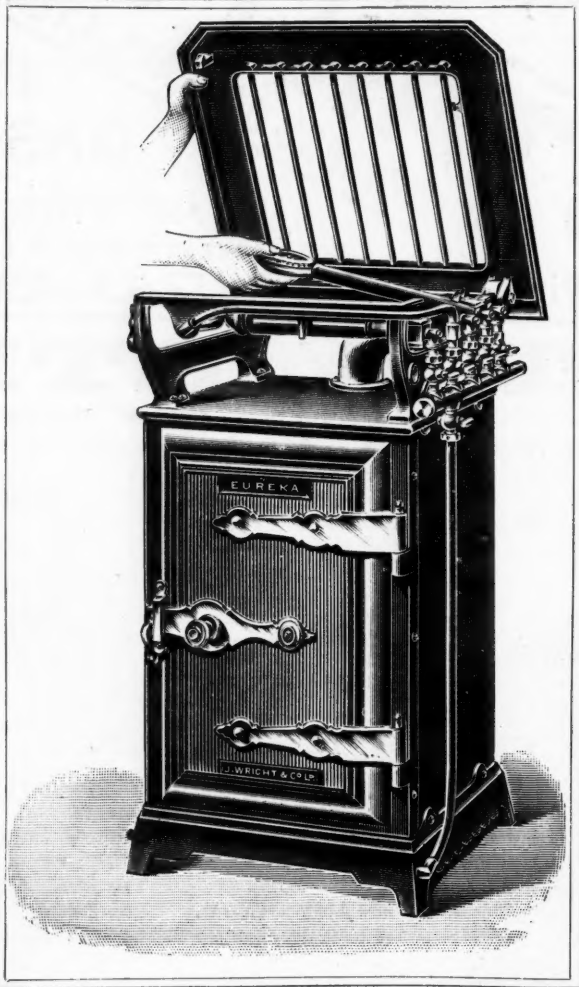

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PROCEEDINGS AT THE THIRTY-FIFTH ANNUAL GENERAL MEETING,

HELD AT

THE EXHIBITION HALL, BELFAST, JUNE 21, 22, AND 23, 1898.

Mr. JAMES STELFOX, M.Inst.C.E., President.

INAUGURAL ADDRESS.

Gentlemen,—I have once more to express to you my grateful appreciation of the high honour you have bestowed upon me in electing me as your President for the present year. The only tendency towards a feeling of regret that you should have thought me worthy of so great a compliment, is experienced as I find myself under the necessity of facing that most serious obligation which custom has imposed upon Presidents—the preparation of the Annual Address. If I had the power to convey to you any information not possessed by others, I might feel that there was some justification for occupying your time and attention; but our extremely well conducted technical journals so promptly publish all matters interesting to the profession of gas engineering, and the Presidents of the various District Associations so ably deal with all such subjects in their addresses, that I feel hopelessly incompetent to claim your attention on the ground of anything new I have to bring before you. I shall, therefore, have to throw myself upon your kind indulgence, and ask you to consider the few remarks I shall make as intended merely to put on record the present position and prospects of the gas industry, and not as an attempt to tell you anything you do not already know.

Before proceeding to refer to gas matters in general, permit me to congratulate you on the prosperous condition of the Institute, both as regards its membership and also in respect of its financial condition. We are not only out of debt, but have a handsome balance of receipts over expenses; and the special funds are in a thoroughly satisfactory state.

A review of the position of the gas industry would certainly be incomplete if no reference was made to the subject of electric lighting. I have not the slightest intention of dragging you through the mazes of comparative figures purporting to show the relative cost of the two systems of illumination—not that I have any objection to figures, but because I am sure you have had enough of them, and have quite made up your minds on the subject. I think I am right in saying that the electric light has never exercised a depressing influence over members of the gas profession. We recognize it as the youngest and, shall I say, the most brilliant member of a brilliant family. Its capacities have been supposed to be so abnormal that a very protracted period of infancy has not been grudged for it. It has been praised and petted, and rather spoiled by the coddling it has received; and it would not have been strange if the elder children had at times felt disposed to give it a pinch or two, seeing that they were somewhat starved, and occasionally even had their pocket-money seized, to satisfy the very great expense required for the youngster's education. And more especially would such a disposition have been natural when the child made no end of boasting that he was going to turn the rest of the family out of doors as soon as he could grow up. I do not, however, think that this feeling reached a high pitch; and the worst that has been wished for the brilliant infant has been that he might soon become a big boy, and be able to earn his own living.

Electric lighting has not, except in special instances, interfered with the progress and prosperity of gas undertakings. On the contrary, it has largely helped to foster a demand for more light. The big gas-lamp is the natural outcome of the arc light; and the public now expect an amount of illumination in town thoroughfares which was never dreamt of twenty years ago.

As the demand for increased light has arisen, inventors have not been slow to provide us with improved apparatus. The regenerative burners introduced by Frederick Siemens have had many imitators, but no superiors. For business, and especially shop, lighting the users have been able to obtain a duty more than double that yielded by the standard burners, and three or four times that obtained from the burners in ordinary use. This progress, however, seems to be put quite in the background by comparison with the results obtained by means of the incandescent mantle, invented, improved, and perfected by Welsbach. The pioneers of incandescent gas lighting could have had but little idea of the possibilities of the thorium-cerium mantle; and so long as it was possible to obtain as much light per foot of gas by combustion with the ordinary burner as was given by an incandescent burner, the latter offered no attraction to gas engineers. I think we are bound to admit that no better result than this was anticipated; and when the extremely unpleasant colour of the earlier incandescent lights is taken into consideration, it is little wonder that the system was relegated to a back-shelf.

The genius of Welsbach, and the idomitable perseverance and pluck of the chief officers of his Company were, however, destined to bring about a complete revolution in our ideas on the subject. The history of the great Company which has carried the new system to the highest eminence of commercial success is quite dramatic, and is known to almost everyone inside and outside the gas industry. The colossal fortunes reaped by those who have placed in the hands of every gas consumer the means of obtaining the light of 15 standard candles per cubic foot of gas, instead of the 3 to 3½ candles obtainable by the standard burners, or the 2 to 3 candles yielded by the ordinary consumers' burners, have been fairly won. The Incorporated Gas Institute has not been slow to recognize this; and the presentation of the Birmingham Gold Medal of the Institute to Dr. Carl Auer von Welsbach, and its acceptance by him at the Bath meeting last year, constituted a function conveying an honour to each of the parties concerned, and indicating the high estimation in which the distinguished inventor's services to the gas industry are held.

Having at one time had but little faith in gas lighting by incandescence, I am quite free to admit that I have been entirely converted. I have never been one of that ilk which would rather that the world should cease to revolve, than that any of its ideas should be proved to be fallacious. I therefore with pleasure refer to the great improvement in results promised by the new departure of the Welsbach Incandescent Company in the construction of their apparatus.

It will be fresh in the memory of the members that, in 1895, Professor V. B. Lewes introduced to our notice the brilliant burner designed by M. Denayrouze. This burner gave a light equal to 27 candles per cubic foot of gas; but unfortunately, in order to obtain this result, it was necessary to use an auxiliary motor to ensure the thorough admixture of the air and gas at the point of combustion. This naturally placed the burner in the list of scientific appliances, and precluded its use as an everyday machine. A year or so later, a modified form was introduced, which did not require a motor; and those who attended the Institute meeting at Bath last June, had an opportunity of judging as to its efficiency in the Grand Pump Room. It did not give results equal to those obtained by the original burner, but was very satisfactory; and the display of its powers in the Westminster Aquarium in the spring of 1897 may have been seen by many of you. As a practical contribution to the improvement of gas lighting, it seems to have been handicapped by the price demanded for it. Gas suppliers are largely dependent on a class of customers who cannot afford to put down comparatively big sums on capital account, no matter how theoretically economical the investment may appear on paper.

The new "Kern" burner, the ownership of which has been acquired by the Welsbach Incandescent Gas-Light Company promises to give results quite equal to those obtained with the Denayrouze motor burner, while it is free from complication, and is likely to come into the market at a moderate price. A very important feature in the new burner is that, instead of yielding a diminished amount of light when the gas pressure is increased beyond that for which it is rated, as in the case of the old burner, the intensity of the glow is increased as the pressure rises. It is thus possible to adjust the gas consumption so as to give a perfect incandescence of the mantle during the daytime, which becomes more and more brilliant with each

increase of pressure. If this were the only advantage to be obtained, it would be a most important one; but when it is accompanied by an increase of illuminating power from 15 to 27 candles per foot of gas, the result must be the very general adoption of this system of lighting in the immediate future. These results are promised with the ordinary pressures of gas in town mains; but still better returns are to be obtained by the use of specially large mantles supplied with gas at higher pressures than are thus available. With a pressure of from 12 to 14 inches of water the Company claim to have obtained as much as 1500-candle power from a single mantle, with a duty of more than 35 candles per foot of gas. The Directors have arranged for a display of their new appliances during the meeting, and have reserved the morning of Saturday exclusively for us; so that you will have an opportunity of seeing and investigating for yourselves the claims of this really wonderful system.

I have ventured to say that electric lighting has not acted to the prejudice of the gas industry. Allow me to qualify this expression of opinion. There are many communities supplied both by companies and corporations, in which the gas-works have been kept in a state of deplorable inefficiency owing to the fear that the days of the industry were numbered. How often have we been told that it was moribund or dead; and yet it has been called upon to respond to the daily increasing demand for light. Timid directors or members of committees have thought it prudent to abstain from extending their works, with the result that the supply of gas at mid-winter has become a source of infinite anxiety. Nor does the matter end with the strain upon the responsible officials. Of all sources of needless cost of production, one of the worst is congestion. Materials necessary for the reconstruction and repairs of works have to come in; and there is no space convenient in which to store them. They are stacked anywhere, and perhaps have to be moved over and over again before they are finally used. There is a temporary glut in the coke-store owing to a month of mild weather; and there is nothing for it but a reduction of price to enforce sales, though the trouble may be merely temporary. The "penny-wise-and-pound-foolish" idea of saving ground-space is one that cannot be approved of.

In places where a vast amount of plant is placed on a comparatively small area, the cost of labour which would not be required if a reasonable amount of ground were available, greatly adds to the cost of production. In this respect our great railway companies have set us a good example. They have generally retained land along their routes, in order to admit of increase in their permanent way; and in such instances as their requirements have increased to an extent not provided for, they have not hesitated to obtain desirable additions, even at high rates. In connection with this subject, the report recently submitted by Mr. George Livesey to the Edinburgh Gas Commissioners forms most instructive reading. Mr. Livesey calculates that by abandoning an old congested works in favour of a new one, and adopting improved appliances, the city could effect a saving of something like £20,000 per annum—a sum large enough to pay 3 per cent. interest on an outlay of over £650,000. I do not suppose that in all works so large a proportionate saving as this could be effected; but I am certain that, in the case of a very large majority, the putting down of additional plant on ground already too small to permit of economical working has resulted in great additional cost, and the consequent maintenance of a higher price for gas than would otherwise have been necessary. No doubt the evil has in many cases been the result of the pressing necessity for a larger supply of gas. The acquisition of additional land is often a vexatious and tedious undertaking; and the requirements of the district may be urgent. Therefore a new retort-house or gasholder has to be placed on ground which would more profitably have been employed as yard-room; and as each additional movement in this direction involves the handling of an increased quantity of material and the diminution in the space available for dealing with it, the "hand-to-mouth" condition is soon arrived at, in which it has often occurred to me that the place resembles a large shop which is so completely occupied by counters that there is no room for the customers.

The moral of all this (for if we cannot practise we can moralize) is that we should look further ahead than we are accustomed to do when making our calculations for the future. I do not think it too much for the gas suppliers of to-day to think of the requirements of twenty years hence. If we allow the low price of oil or the brilliant "light of the future" to deter us from the discharge of this obvious responsibility, the time will surely come, either to us or to our successors, when our dereliction of duty will be only too apparent. If Brown, who has a prosperous business, will not keep his premises up to the requirements of that business, because he fears that some future Jones or Robinson will arise to share it with him, he will soon find that he has adopted the very surest method for hastening the advent of his expected competitors.

During the past year there does not appear to have been much to record as regards new methods of gas enrichment. The Peebles process, which I have always thought deserved a foremost place among the systems of oil-gas making, does not seem to have continued to make the progress that was expected for it. The reason for this is not very evident; but apparently the separate production of a gas of such high illuminating power as that yielded by this apparatus has been found in practice to have some drawbacks, or the method would have come into more general use. It is understood that the separate manufacture of oil gas is being carried on in Glasgow; and no doubt in good time the interesting results will be communicated to us.

The experiments in connection with the oxy-oil process, which were being made at Huddersfield, seem to have been abandoned. The voluminous reports and correspondence in connection with these trials have only sufficed to place us in a state of bewilderment as regards the result. It need only be said here that neither side has succeeded in convincing the other, and that any complete information must be looked for in the future.

Perhaps there has not been any subject in connection with gas affairs on which the public mind has been more exercised than the position and prospects of acetylene as a means of artificial illumination. There cannot be a doubt that suspicions as to its safety have been many and serious. These may possibly have been intensified by the stringent regulations as to the storage of calcium carbide deemed by the Government necessary for the public safety. I might have chosen to refer at greater length to this most interesting subject; but as you will have the privilege of hearing from Professor Lewes all that is known about it, I will not run the risk of spoiling your intellectual appetites for the feast thus to be provided, by offering such scraps as are at my disposal. I will therefore only say that, brilliant and beautiful as is this latest claimant for honours, it has not yet come into practical use to any considerable extent; nor does it seem at all likely that it will interfere appreciably with the ordinary supply of gas in towns or villages. It is essentially a country-house light; and for the illumination of mansions it may have a future, if it could be made clear that its use did not involve such serious risks to its patrons.

In the various laborious processes connected with gas manufacture the substitution of machinery for manual labour continues, though perhaps somewhat slowly, to make progress. During the past year, several large installations have been fixed, and the use of mechanical appliances extended in many works already having such. As to the desirability of employing machines in all work which involves great physical strain if effected by hand labour, there cannot be a moment's doubt. As to the economic question there will be greater divergence of opinion, as other matters—such as loss of coal by spillage, and imperfect carbonization—must be considered, as well as the mere comparison of wages and wear and tear. No doubt the introduction of machines into retort-houses not thoroughly suited for them, to a considerable extent affects the cost of working; and in many works, where the employment of mechanical power does not begin and end with stoking appliances, but includes the "handling"—if I may be excused for the misnomer—of the material from truck or barge to the coke-store, a very substantial reduction is effected.

These labour-saving appliances must be reckoned to include the use of inclined retorts, which came upon us with a boom some thirteen years ago, and seemed likely to take possession by storm of every gas-works in the kingdom. The adoption of the system seemed, however, to receive a decided check; and no doubt it has contributed very largely to that omnivorous receptacle the scrap heap. Nevertheless, as in the case of many other systems, out of that

portion of the heap a vast amount of experience has been evolved; and at the present time "slopers" seem likely to have a much more prominent place in gas-works construction than the one they have till lately occupied. I am personally obliged to our friend Mr. Shoubridge for consenting to give us the valuable information which he possesses on this subject; and I shall not therefore anticipate his description of the most recent developments of the system.

The probable effect of the new Workmen's Compensation Act, which will come into force on July 1, has excited a good deal of speculation; and since the Insurance Companies have expressed, by their high tariff, their estimate of the responsibilities which it will throw upon employers, there has been something approaching a panic in industrial circles. That there has been miscalculation somewhere seems certain, from the vastly different figures arrived at by the Companies and the author of the Act. The subject will no doubt be fully discussed in connection with Mr. Ellery's paper. If it can be shown that the Act will tend to add to the security of life or limb in our large manufacturing establishments, without unduly or unfairly taxing the proprietors, its addition to the Statute Book will be largely justified. This can only be judged by results; and for these we must wait till it has been for some time in operation.

The result of the adoption of Mr. Vernon Harcourt's 10-candle pentane burner by the Metropolitan Gas Referees as the standard for their official testing, in lieu of the time-honoured sperm candles, will be looked forward to with much interest. It cannot be said that the change has been made hastily, seeing that the pentane standard was exploited as far back as fifteen years ago. Mr. Harcourt read a paper on the subject at the Institute meeting in 1883; and in his introduction he referred to the vagaries of the standard candle. Since that time, the question of its adoption has been frequently discussed. It remains to be seen if, in its most recent form, it will obviate the difficulties and disputes constantly arising in connection with gas testing.

Now with respect to water gas, carburetted and uncarburetted, I think I may say that, so far as the former is concerned, it has been the greatest and most successful departure from old methods of gas making that has characterized the last decade of the century. Possibly by the early years of the coming century the latter of the two may come more prominently into use. But before this can be possible in the illumination of towns, the public mind will have to be convinced as to the superiority of lighting by incandescence; and perhaps it will be also necessary that some much cheaper and less fragile form of burner shall be available.

It is just four years since I had the honour of communicating to the Institute the results of six months' experience in the production of carburetted water gas by means of the Lowe double superheater apparatus, which had found so much favour in the United States of America, the birthplace and training school of the industry. At that time I had found, to my very agreeable surprise, that a system which I had only reckoned upon as a help in emergency was likely to prove an important factor in our daily work. After a further year's experience, so thoroughly satisfactory were the results that a large addition was made to the plant; and we have continued to work it without intermission till the present day. Increased intimacy in this case has led to increased appreciation. The drawbacks I expected, though they had but a shadowy existence, have not materialized. On the other hand, advantages never thought of have from time to time become apparent; so that in my own mind I am unable to conceive such a condition in that of another as would place him in antagonism to so efficient a stand-by in case of need. I suppose there are vigorous natures who revel in hard work and worry, and for whom the weary waiting for retorts to be ready for use affords some sort of penitential delight, of which they would not deprive themselves by merely turning on the tap of a water-gas plant. Speaking for myself, I have had enough, and too much, of such experiences while they were unavoidable, and am only too glad to have the opportunity of availing myself of the comparatively quiet life rendered possible by the possession of efficient water-gas appliances. It is a satisfaction to be able to receive a card conveying a friend's best wishes for "A Happy Christmas," without necessarily feeling that one is being made the subject of satire or derision.

All this may be beside the question, inasmuch as economy must be considered, and, clearly, personal comfort must not be allowed to outweigh the interests of those whose property is placed under our control. There are many works too small for the profitable employment of a water-gas plant; and there are others whose position may be such as to involve certain conditions as regards cost of coal or carriage of oil affecting the ultimate cost of gas to the advantage of the one system or the disadvantage of the other. Such cases must be dealt with on their individual merits. He is the ablest general who turns to best advantage such materials and appliances as are at his disposal, and who plans his campaign with the most careful regard to his surroundings and the obstacles to be overcome.

There are many who, with more or less imperfect knowledge on the subject, rail at carburetted water gas, who are indirectly largely benefited by its introduction into general use. In making comparisons between the two systems, it must not be forgotten that within the past few years the price of that almost obsolete enricher, cannel, has been greatly modified, entirely through the use of oil in one way or another in the enrichment of gas. In my own neighbourhood, all the works are getting better prices for their residuals as the result of our manufacture of carburetted water gas. In this respect alone, if the public would only realize it, the new system deserves well at their hands. As regards our particular experience in Belfast, the effect of the change has been to bring down the cost of coal gas to a figure which could not have been reached on the old lines; and all the economy represented by the saving in cannel and the increased yield from residuals is credited to the cost of coal gas, though in reality it is achieved by the large use of water gas. It is therefore clear that, in cases where both systems are at work, the just claims of the newer one cannot be determined by the mere comparison of the figures as they appear in the accounts. That my own experience of the system is not an isolated one, is clearly shown by the fact that, whereas at Midsummer of 1894 only three concerns were working it in the United Kingdom, in 1896 the number had increased to sixteen, and at the present time over forty works have adopted it; and the experience has been so generally satisfactory, that we may claim for it a practically unanimous verdict of approval. It seems also clear The Gaslight and Coke Company, who first experimented with the plant in England, must have satisfied themselves of its economy, seeing that they have so largely increased their producing power in this direction.

As to the wonderful statements that from time to time appear in reference to the cost at which coal gas can be produced, I desire to touch but lightly upon them. Figures may be so arranged as to prove anything, so long as they are merely selected figures. The compilations annually published in "Field's Analysis" are open to the inspection of all. They include the returns of leading undertakings whose united production of gas represents more than half of the entire production of the kingdom. At a recent meeting of the North of England Association, Mr. David Terrace claimed to have produced carburetted water gas of 24 candles at 14d. per 1000 cubic feet into the holders, though he had to bring his oil on to the works in railway tank-waggons. With oil-tanks *in situ*, and direct communication for discharging tank-steamers, he reckons this cost would be reduced to 11·7d. per 1000 cubic feet. I do not think these figures represent the best that can be done with oil at 2d. per gallon, or possibly a little under that figure. But they are good enough to compare very favourably with the best of those tabulated by Mr. Field; and so long as these tables are allowed to pass as accurate, we must accept their testimony as reliable.

For the use of carburetted water gas, however, I venture to claim other economies than that of mere cost of working. To give the results of personal experience, I may mention that a complete water-gas plant, capable of producing 4½ million cubic feet per diem, cost us less than £24,000, including the necessary buildings. Existing condensers, purifiers, and exhausters, unfortunately not equal to the total capacity of the plant, were utilized; but an outside estimate of the cost of these, sufficient for the full requirements, would be—

For condensers	£3,000
For exhauster and house	1,500
For purifiers	8,000
	£12,500

This makes a total of £36,500. With such a plant at full work, one could depend upon a production of 28 million cubic feet in a week, which would be at call at any moment, to be used or held in abeyance as circumstances required. A gasholder to contain 7 million cubic feet would cost, with tank, at least £70,000; so that, as an emergency plant, the gasholder would cost double and give but one-fourth the security afforded by the other. The accumulation of stock in a gasholder can, in case of any sudden demand, only be used once; while a producing plant capable of being promptly brought into action represents a continuous relief. In former years the advent of a dark week meant with us the hurrying up of extra settings and the frequent checking of pressure so as to avoid the "no bread" condition at the week-end by providing only the "half loaf" at the beginning. Since we have worked the new system, the necessity to reduce pressure has never occurred; but, on the contrary, when a period of special darkness has been experienced, we have been enabled to give the extra supply which was required, seeing that through the winter months we have always kept an extra set alight—working two sets alternately, and when necessary keeping both in action.

Now, what is the objection to the employment of this system? I have designedly used the singular number, because I think the only allegation worthy of notice is that the carburetted water gas contains a larger proportion of carbonic oxide than coal gas. It is surprising how the public mind can be influenced by "a cry." From the time when the prestige of "Diana of the Ephesians" seemed to be in peril to the present, persons more or less interested or fadded about certain things have appealed in this way to the popular feeling. The votaries of Old King Coal have not been exceptions to the rule; and though colliery owners and agents are usually not men wanting in intelligence, and therefore not silly enough to openly declare war against a supposed enemy on insufficient grounds, they are possessed of enough human nature to be capable of taking advantage of, and encouraging in a quiet way, any feeling that may seem to be unfavourable to their opponent.

The results of the valuable researches of Dr. Haldane, as to the action and effects of carbonic oxide, have in some quarters been most unfairly, and in many cases most ignorantly, used. That some of the medical journals should have committed themselves to such statements as that carburetted water gas is specially dangerous on account of the absence of smell, must seem strange to those who know how pungent and disagreeable is the effect produced by the smallest escape of the gas. With those who have associated themselves with the opposition to the use of carburetted water gas, there seems to be no element worthy of consideration but the one. Accidents from coal gas crop up from time to time; but they are of no consequence, because in coal gas carbonic oxide is only present in the proportion of 6 to 10 per cent. Therefore people poisoned by that gas die by misadventure. If they inhale a mixture containing water gas with (say) twice the proportion of carbonic oxide, the case seems to assume quite a different aspect. As a matter of fact, there are other very deadly ingredients in coal gas, though their characteristics are not so well known as those of carbonic oxide. But the fact remains that coal gas, if inhaled in any quantity, usually kills, and carburetted water gas can do no more. The recoveries from asphyxiation appear to be quite as common with the one gas as with the other. In neither case is the material supposed to be used as a tonic; and ample warning of its presence is in each case given to anyone possessed of the slightest sense of smell.

Accidents will happen even to those exercising the utmost care; and if people will blow out their gases, or prefer to turn on their gas-taps before finally retiring to rest, the vendors of a useful commodity which is supplied for external use only, are surely not to be blamed for such negligence. Used as an illuminant, carburetted water gas is hygienically superior to the other; and even when inhaled, the results in practice do not seem to be any worse. Careless people and children get burnt, yet house fires are not discontinued. Drowning fatalities occur, but no one suggests that our rivers, canals, or lakes are features to be regretted. Electric currents kill, but the suppression of electric lighting is not therefore advocated. If our medical friends, professional and journalistic, would devote their great energy and undoubted ability to the amelioration of the sad condition of the country as regards preventible diseases, they would be conferring upon the community a much greater benefit than they can possibly achieve by creating needless alarms in reference to the dangers of illuminating gas.

It would appear that Dr. Haldane does not look upon the presence of carbonic oxide in practice in that pessimistic manner that some of the coal gas enthusiasts have imagined. In his evidence before the Board of Trade Committee concerning the ventilation of the Metropolitan railway tunnels, after referring to the impure state of the atmosphere contained in them, he says: "There is no reason to suppose that regular exposure to the atmosphere of the tunnel produces permanent ill-effects or shortens the life of any healthy person." In reference also to the pollution of the air in factories, he states: "There is perhaps no other occupation in which men are so constantly exposed to air containing noticeable percentages of carbonic oxide; and it is a fact of considerable interest that no permanent ill-effects are produced in persons accustomed to the air." Dr. Haldane also refers to the somewhat remarkable fact that the men employed on the Underground Railway "are exceptionally healthy, in spite of constant exposure to the impure air;" and still more astonishing is it that, in the Provident Society connected with the railway, the amount of sickness among those classes of men working in the tunnels is barely more than half the proportion of that of the men employed in the workshops of the Company. I do not, by quoting these facts and figures, attempt to argue that carbonic oxide *or any other constituent of coal or carburetted water gas* is desirable in the atmosphere we have to breathe, but merely to show that the presence of small percentages of these gases is not so deadly a matter as it is sometimes represented to be.

In the interesting lecture delivered by Professor Lewes at the Bath meeting in June last year, the lecturer foreshadowed a great lighting future for plain water gas used with Welsbach mantles. The learned Professor, in the same connection, referred to the results obtained by the Dellwik system, by which 77,000 cubic feet of water gas were produced from a ton of coke; and since that time upwards of 91,000 cubic feet are said to have been made per ton. As justifying Professor Lewes's anticipations, it is interesting to find that the lighting of the Vienna General Hospital by plain water gas made on Dr. Strache's method has since been satisfactorily accomplished. The results claimed are that, for a given amount of light, the heat developed was only about a third of that produced by a similar burner consuming coal gas, and the production of carbonic acid only one-half; while comparing it with the products of coal gas consumed in ordinary burners, the heat produced was only one-eleventh, and the production of carbonic acid less than one-seventh. The faculty in Vienna seem to be quite able to appreciate the hygienic superiority of the system; and it is something in the way of a commentary on the fanciful objections of which we have heard, that the experiment should have been made in a hospital. That such a system is likely very soon to supersede the use of ordinary illuminating gas, I should be slow to prophesy. More probably the tendency will be to produce gas of lower lighting power, so that, while not shutting out those who still wish to use the old burners, it may be possible to provide those who adopt incandescent lighting with a supply at a cheaper rate. Possibly a cheap burner and mantle may be made available; and with the fact plainly in view that a non-luminous gas admirably suited to such a system could be made for one-fourth of the cost of producing ordinary gas, it would not be surprising if at a very early period the incandescent system should become the universal one.

The supply of such a gas would have most important results on the production of power for industrial purposes. Mr. T. O. Paterson, of Birkenhead, has favoured me with the results of some experiments on the use of uncarburetted water gas in a gas-engine; and I regret that he did not consent to submit them in the form of a paper at the present meeting. I trust, however, the occasion is only postponed. The results of many trials with varying loads were as follows:—

Town gas (25 per cent. carburetted water gas).	24·9 c. ft. per brake horse power per hour.
Carburetted water gas .	27·6 " "
Uncarburetted " . .	44·1 " "

These consumptions the experimenter reckons would be reduced, if a modern engine were in use, to—

Town gas	15·0 c. ft. per brake horse power per hour.
Carburetted water gas .	16·6 " "
Uncarburetted " . .	26·5 " "

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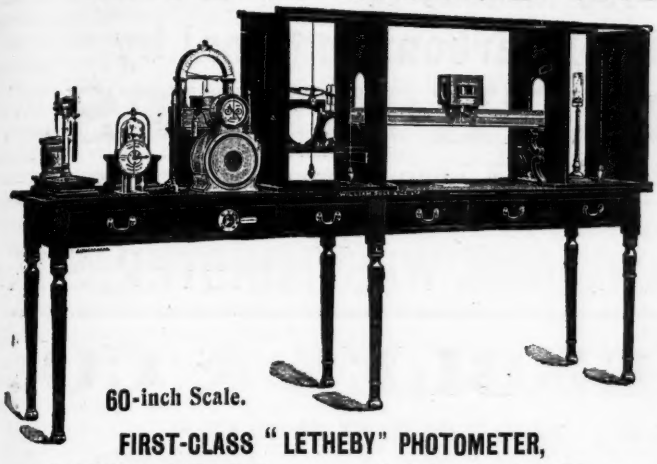

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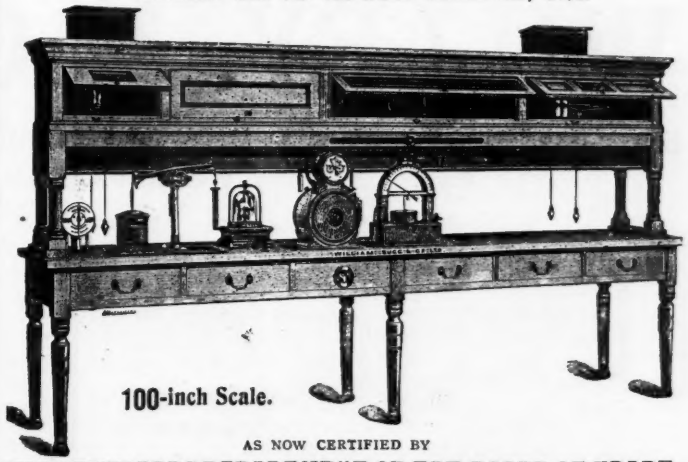

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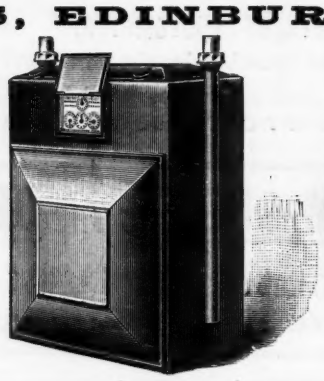

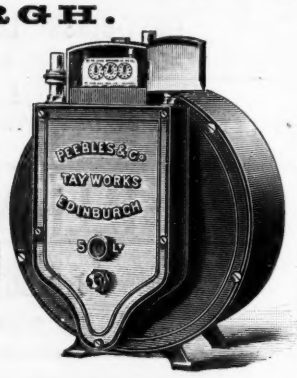

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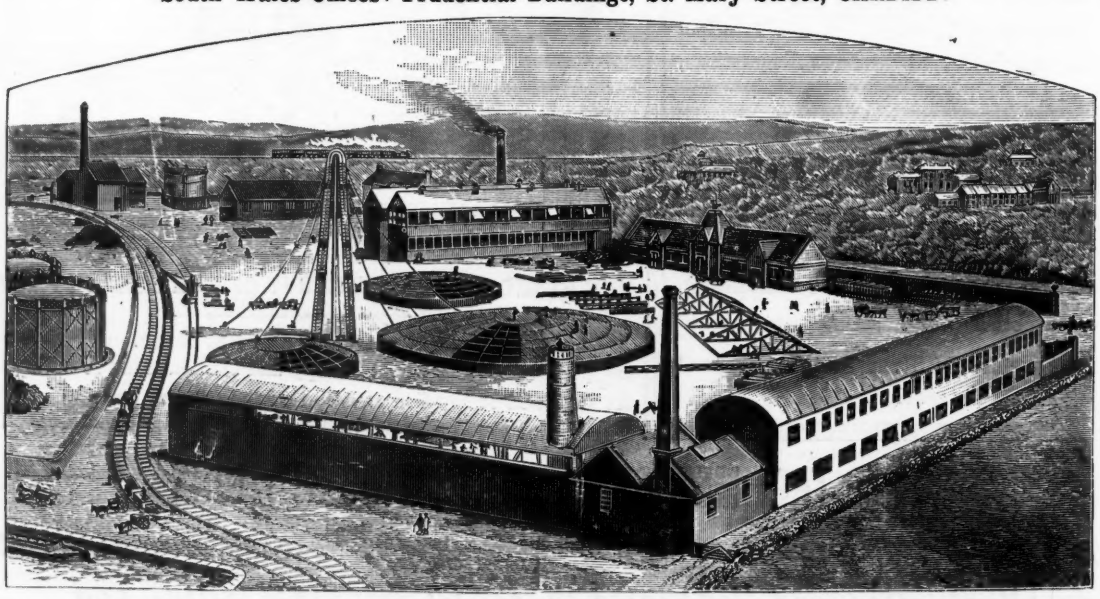

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Telephone 132. Telegraphic Address: "WILLEY, EXETER."

Mr. Paterson reckons his cost of plain water gas at 2¾d. per 1000 cubic feet into the gasholder, taking coke at 7s. per ton. With such fuel available, containing over 90 per cent. of combustible material, and at a time when motors are not only "in the air" but in the streets, surely it would be more reasonable to expect in this direction the development of a system of tramway traction than in the many more pretentious and costly methods continually under discussion in all our large towns. It would seem that the first vehicle to be successfully worked by a motor should be a tramcar, and that the proper method of obtaining the necessary power would be found in the use of cheap gaseous fuel in an engine acting directly on the axles of the vehicle. Such a method of propulsion is successfully at work in several places with ordinary town gas. It is reasonable to suppose that when once the principle is firmly established, the production of the cheaper fuel—not necessarily, but in all reasonable probability, supplied by gas undertakings—will follow as a natural result.

Taking a comprehensive view over the field of artificial illumination, I think we may fairly congratulate ourselves on the position held by our own particular section. There is an old saying that "threatened people live long;" and possibly the sentiment may apply equally to industries as to individuals. At any rate, while stock in some of our supposed competitors is looked upon with suspicion, and is worth a good deal less than twenty shillings in the pound, gas shares continue to bring in good returns and command high prices. The future may have many surprises in store for us. But the system has yet to be invented or discovered which is to depose that of gas lighting from the commanding position which it occupies as pre-eminently the Light of the Present; and it is with this period we are most concerned.

The Chemical Industry of Russia.—According to some statistics on the above subject which recently appeared in "Engineering," though Russia produced 103,000 poods of aniline and alizarine dyes in 1892, already worth more than 2,000,000 roubles, the raw materials could not be entirely obtained in the country. It is noteworthy that Russian alizarine is prepared from anthraquinone (not from anthracene), with the help of caustic soda, chlorate of potash, and sulphuric acid. The coal tar of coke ovens is collected, and benzine, anthracene, &c., are isolated from it.

An Automatic Meter Register.—By an announcement which appears in our advertisement columns, it will be seen that a new revised and improved edition, specially adapted for "slot" meters, has been prepared of the book projected by Mr. R. Peake Keys about twenty-five years ago. Its principle is to keep a record of each meter upon one line on the column system, with record of ten meters on a page. An index has been added, and the size very much reduced. We do not know of any book yet published which is so easy to keep, and so complete for this purpose. The book has outlived the kind of opposition it met with a quarter of a century ago; and as it appears specially adapted for "slot" meters, it is likely to be much in demand. The practical working of the book can be seen by making an appointment with the author, at his new office, 4, Brighton Chambers, Denman Street, London Bridge Station, any Friday before one o'clock.

A Criticism of the New Welsbach Burner.—A London correspondent of the "Zeitschrift für Beleuchtungswesen"—a paper which usually displays a hostile attitude towards the Welsbach Companies—makes a criticism of the new Welsbach burner of which the following is the substance. The new burner, the advent of which has been talked of for months, and announced in all official and unofficial newspapers, differs considerably in appearance from the previous and well-known burner. In technical circles, however, it is not quite understood how the burner justifies all that has been claimed for it. The mantle is placed about 1·2 inches higher from the gas-inlet than in the old burner; but as neither the gas pressure nor the air supply can be regulated, evils—such as the deposition of soot on the mantle at high gas pressure, flashing-back of the flame, buzzing of the burner, &c.—which should have been remedied can scarcely have been affected. The claim that a chimney is unnecessary for the greatest development of the flame is wholly fictitious, as any incandescent light can be used without a chimney; but the candle power attained will not be the same. Another fault is the great height of the new burner, which will make the use of a large number of existing gas brackets and pendants impossible. The arbitrary and useless change in the size of the globe-ring also makes the use of existing globes impossible. It must not be assumed that the new burner will serve to stimulate again the use of the incandescent light. In order that this should happen, a stronger mantle must be produced, and the price of the burners and mantles must be very greatly reduced. The business will be much quickened when the Welsbach patent rights expire at the beginning of the forthcoming year.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1483.)

Business on the Stock Exchange last week did not attain to more than very moderate proportions, for which fact the counter-attractions of Ascot and the brilliant weather in the latter half of the week were largely responsible. There was also a dull tendency in many markets (though in some it would be hard to say why), which lasted right through up to the close. The consequence was that prices of pretty well all descriptions showed at the finish a falling off from the opening figures. At the same time, however, nowhere did the retrogression amount to anything considerable. The Money Market is very easy, and it would be easier still but for the imminence of the close of the half year, when much money is called in which is free to go out again the next day; and the prospects of July are in favour of a very pronounced degree of ease. Business in gas was decidedly below the average on the whole, although one or two issues were, for special reasons, more active than they ordinarily are. The flattish tendency which ruled the markets in general extended to Gas securities; and, although prices are not uniformly lower, yet the falls considerable outweigh the rises. In Gaslights, the "A" showed early signs of reaction from its recent smart advance; and it got weaker as the days went on. The final mark on Saturday was 295½—the worst of the week. A little business was done in the secured issues; but none of them commanded very good figures, though the quotations did not fall. South Metropolitan, on the contrary, was strong from the start, and finished up with a gain of a couple of points. Commercial old was inclined to droop, and was a loser to an equal degree. The Suburban and Provincial contingent was quite neglected; and the only move was a drop in the buying price of British. The Continental Companies were quite devoid of animation; and the tendency was decidedly weak. Other movements were quite unimportant. Bombay had an advance; and Buenos Ayres debentures rose a point. In Water, business on one or two days looked like becoming more lively; but it soon died away again. The tendency, however, was good, and one or two quotations made a small advance.

The daily operations were: On the opening day, there was no great show of activity in Gas; and prices mostly were rather easy. Continental Union receded 3; but South Metropolitan rose 1. Quietness for the most part prevailed on Tuesday, though South Metropolitan continued brisk. Gaslight "A" fell 3. There was a little more doing on Wednesday. Prices still ruled easy; but quotations did not undergo any noticeable change. Thursday was another quiet day, with no recovery of a firmer tone. Imperial Continental fell 2; but Bombay rose ¼. In Water, the buying price of Grand Junction was 2 higher; Lambeth gained 2; and Southwark ordinary, 1½. Business remained just about the same on Friday. South Metropolitan rose 1; but Commercial old receded 2. Saturday was dull. Gaslight "A" fell 2; and Imperial Continental, 1; but Buenos Ayres debenture improved 1.

ELECTRIC LIGHTING MEMORANDA.

The Passing of the Bermondsey and Marylebone Provisional Orders—The Question of Fair Play and of Expediency in the National Interest.

The passing of the Electric Lighting Provisional Orders (No. 12) Bill by a large majority of the House of Commons, hardly settles the question raised in this column last week as to the acceptability of the principle of Vestry competition with private enterprise. It has commended itself to the wisdom of Parliament that the Parochial Authorities of Bermondsey and St. Marylebone should be empowered to supply electricity within their respective districts, notwithstanding the existence in the same areas of electricity supply Companies enjoying the same statutory rights. The question of the expediency of this competitive arrangement was raised, on the order for the second reading of the Bill, by Mr. Cripps, who had the support of Mr. Kimber and Mr. Knox. As we remarked last week, the cases both of Bermondsey and Marylebone were dealt with by the Board of Trade upon their individual merits; but, somewhat unfortunately, they were bound together in the same Confirmation Bill. Mr. Knox pointed out the difficulty thus created. The cases are not on all-fours, inasmuch as in Bermondsey the local Electric Light Company have not exercised their statutory powers to supply; whereas in Marylebone the Company are in full and growing activity. The fundamental question for Parliament to settle was, however, in both instances the same. Mr. Cripps put it in the clearest way when he told the House that the principle involved applied not only to electric lighting companies but to all industrial public supply undertakings, whether for the construction and working of tramways or for the supply of gas or water. He showed that there was no precedent for the legislation proposed at the instance of the Board of Trade; and he asked the House to consider whether it was fair that where a company had sunk capital on the faith of a Provisional Order running for 42 years, the ultimate purchasing authority should be allowed to come in, and, by means

of rate-aided competition, depreciate the company's property, or crush out private enterprise altogether.

Here is the main question. On the face of it, the principle involved in the Bermondsey and Marylebone Orders is not fair to the existing Companies. It would not be sanctioned in regard to gas or water supply, where private enterprise is not subject to a time-limit. It might be thought that the limitation of an electric lighting company's tenure of their district to 42 years should carry with it the grant of undisturbed enjoyment for this period. Considering the matter in this light alone, it seems anything but equitable that an undertaking which may be bought on the basis of structural value after 42 years' working should meanwhile be subjected to competition in business by the aid of the rates to which it contributes. Very naturally, the private electric lighting interests thus threatened take a grave view of the condition proposed to be created. The position is discussed very temperately by the "Electrician," which admits that the Board of Trade acted strictly in accordance with the law in granting the Bermondsey and Marylebone Orders. There is no denying this. The Electric Lighting Act of 1888 expressly states in the very first section that "the grant of authority to any undertakers to supply electricity within any area, whether granted by Licence or by means of a Provisional Order, shall not in any way hinder or restrict the granting of a Licence or Provisional Order to the local authority or to any other company or person within the same area." The law of the subject is therefore perfectly clear. What remains is to ascertain the nature and character of the justification of the Board of Trade for acting upon it in any particular instance.

Our contemporary rightly observes that it has been the practice, though not the declared policy, of the Board of Trade to grant only a single Provisional Order for provincial areas, but to permit of competition by the granting of two Orders to rival companies in the majority of the Metropolitan areas. The reason for this difference of treatment arises probably from commercial considerations. With but one or two possible exceptions, the character of provincial areas is not such as to warrant the expectation that they could support two electricity-supply undertakings. With the same exceptions, the largest provincial undertakings of the kind are smaller than the smallest London concerns; and several London districts are better able to support two electric lighting companies than the provincial centres can their one venture. This must be the determining reason why the Board of Trade have exercised their undoubted discretionary power, and sanctioned competition in electricity supply in certain Metropolitan areas. Another, but a secondary, consideration is that of the system of supply. A company proposing to enter into competition with another company already supplying electricity in a certain area, would have a better chance of gaining the approval of the Board of Trade if the intended system of supply were different from, than if it were similar to, that of the established concern. It is understood that these reasons justify the Board of Trade in permitting competition between electric light companies. But is the competition of a local authority, having command of the rates, with a company possessed of a Provisional Order, justified on the broad ground of public policy? This is the question which the recent vote of the House of Commons does not dispose of. All that the vote meant was that the Board of Trade had not acted otherwise than according to the meaning and letter of the Electric Lighting Act, 1888, in granting the Bermondsey and Marylebone Orders, and that these Orders are in accordance with the terms of the Act. It remains to be seen, as our contemporary puts it, "whether it is not contrary to public and national interests to allow genuine and honestly managed company undertakings to be undermined by springing upon them in this way the rate-aided competition of local authorities." There will have to be considered the effect of this proceeding upon the attitude of capitalists towards electricity supply schemes. Capital has already shied once at the original electric light legislation of this country, which had to be amended in consequence. If it takes alarm again—this time at an unexpected development of the amended legislation—will the national advantage be subserved thereby? We doubt it; and in this are in agreement with our electrical contemporary.

Hydro-Incandescent Gas-Light Company, Limited.—In another part of the "JOURNAL" will be found the prospectus of this Company, the formation of which was announced in our issue for the 7th inst. (p. 1337). It will be seen that the Company, the capital of which is £200,000, in £1 shares, are working under a contract with the Welsbach Incandescent Gas-Light Company, Limited. The object is the acquisition of the whole of the British, Indian, Australasian, South African, and Canadian patent rights, and all other rights incidental thereto, of the hydro-incandescent gas-light, and the benefits of a valuable licence with the Welsbach Company, whereby the latter undertake, for a minimum period of five years, to manufacture and sell the apparatus, paying over to the new Company 50 per cent. of the gross profits. In the event of the contract being determined, the Company are to be deemed to have a licence to use the Welsbach mantles and burners, and the Welsbach Company are to supply these appliances at a discount of 30 per cent. from the current price. The application list will open to-morrow, and close on or before Friday afternoon.

PERSONAL.

Mr. W. T. BUTLER has succeeded the late Mr. J. Young as Chairman of the Dorking Gas Company; and Mr. HERBERT YOUNG is the new Vice-Chairman.

Mr. M. BELLHOUSE, formerly Manager of the Goole Gas-Works, who has lately been acting as foreman under Mr. Matt. Dunn, has sent in his resignation, which has been accepted by the District Council.

Mr. FRANK P. TARRATT, who, as announced last week, has been appointed Works Manager at the Darlington Gas-Works, was last Thursday presented with a handsome timepiece, by the staff and workmen of the gas and electric light undertaking of the Leicester Corporation. The presentation was made in the Reading and Recreation Room at the Aylestone Road works, in the presence of representatives of the donors, by the Engineer, Mr. Alfred Colson, M.Inst.C.E., who, in heartily congratulating Mr. Tarratt upon his appointment, expressed regret at losing him after a service of twelve years. Mr. Tarratt, in acknowledging the gifts, assured all of his great appreciation of the good wishes expressed, and thanked them sincerely.

On Saturday, the 11th inst., Messrs. Westwood and Wright gave the employees at their Round Oak and Queen's Cross works, to the number of about 260, an outing to Arley, to celebrate the coming of age of Mr. EDWARD OLIVER WRIGHT, eldest son of Mr. E. T. Wright, of Stourbridge. Dinner and tea were provided at the Valencia Arms. A noteworthy feature of a very pleasant gathering was the presentation to Mr. E. O. Wright of a silver inkstand (with pen and pencil holders to match) and a silver flask, by the Round Oak workmen, and a spirit-stand by those engaged at Queen's Cross. The health of the recipient was drunk with much enthusiasm. Mr. Wright expressed his thanks for the gifts, and his appreciation of the good feeling shown towards him.

On the occasion of his leaving the service of the British Gaslight Company at Hull to take the appointment of Engineer and Manager of the Bombay Gas Company, Mr. F. W. CHAMBERLAIN was presented by the employees with an illuminated address, beautifully and artistically executed by one of the workmen, together with a silver-plated tea and coffee service and an oak tray, in token of their esteem. Mr. C. Clubley presided. The presentation was made by Mr. Bellamy, who paid a high tribute to Mr. Chamberlain's sterling qualities, and wished him every success in his new undertaking. Mr. Chamberlain expressed his thanks for the gifts, which he said he should treasure in his far-off home, as they would remind him of the many happy years he had spent in England.

OBITUARY.

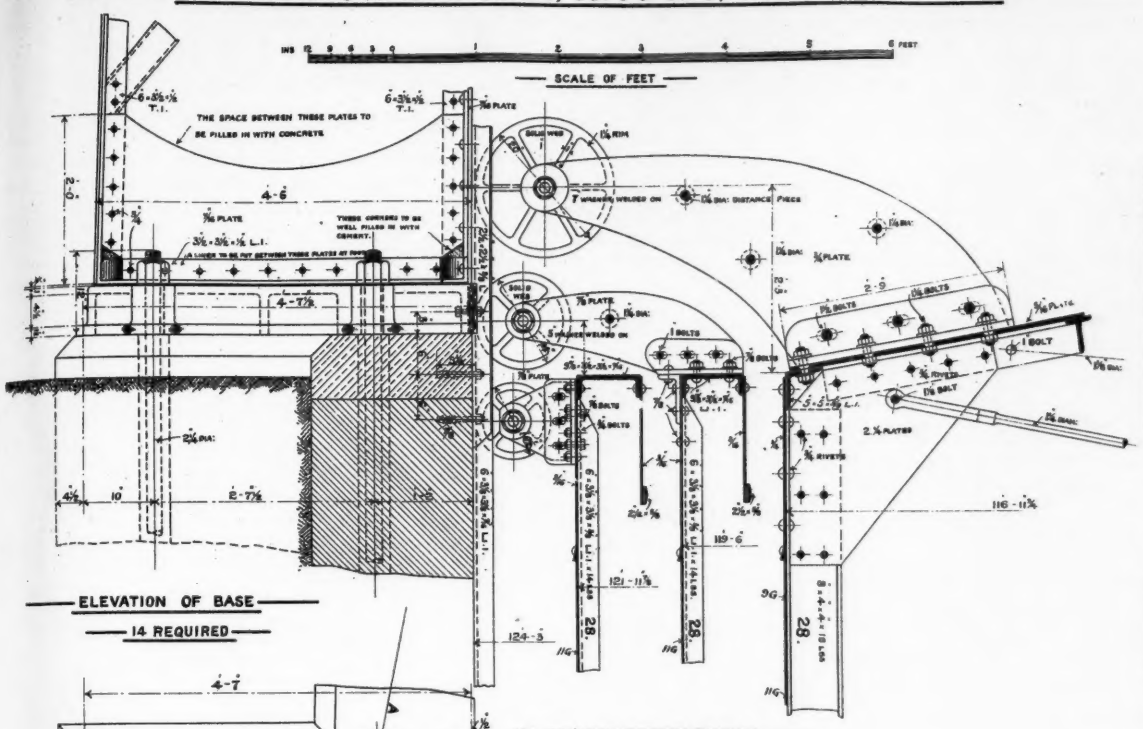
Mr. SAMUEL BURKETT, J.P., for many years Vice-Chairman of the old Chesterfield Water and Gas Company, died suddenly at his residence, Stubbing Court, near Chesterfield, on Monday last week.

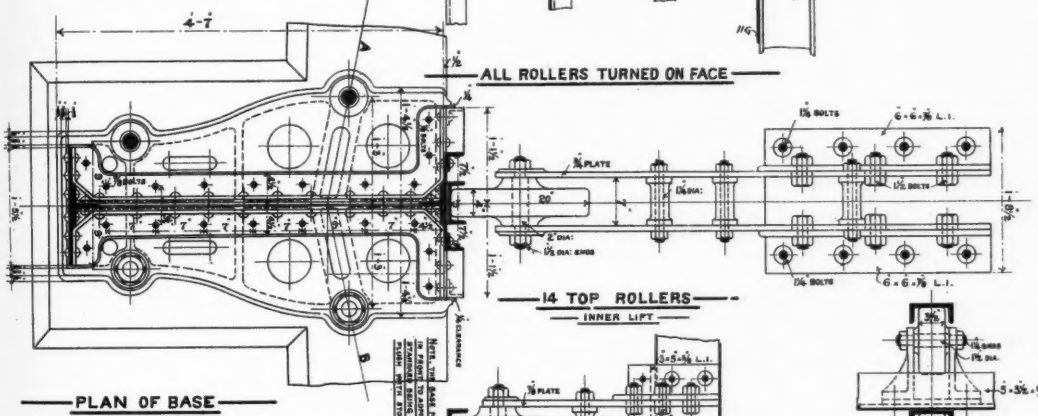
The death is announced of Mr. W. CRABB HALL, J.P., of Cambridge. He was a Director of the local Water Company, and an Auditor of the Trowbridge Water Company. He was also a member of the Cambridge Town Council; and three years ago he filled the position of Mayor.

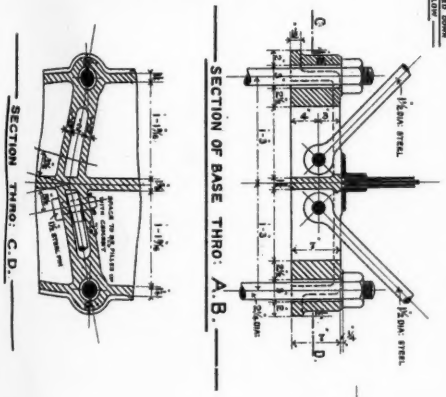
We regret to announce that Mr. JAMES ELY, the Secretary and Manager of the Abingdon Gas Company, whose retirement on account of ill-health was recently notified in the "JOURNAL," died on Monday morning last week at the age of 60. He was appointed Secretary and Manager of the Company exactly twenty-five years ago; and his judgment and skill piloted the undertaking through many difficulties, especially during the great coal strike. The Directors frequently paid him a high compliment for the excellent manner in which he performed his duties; and his retirement was much regretted. Mr. Ely was a native of Leeds, and at an early age became Chief Inspector to the Gas Company of that town. He subsequently held similar appointments at Sunderland and Dublin, after which he returned to Leeds as Government Inspector under the Sale of Gas Act. In 1873 he succeeded the late Mr. John Wilson in the service of the Abingdon Gas Company, whose works were then very inconveniently situated. In 1887 new works were completed; and in the promotion of this scheme Mr. Ely was of valuable service to the Company, whose requirements he accurately gauged with more regard to economy than was noticeable in the original plan submitted to the Directors. Later on, by painstaking attention to the interest both of shareholders and consumers, he successfully coped with the problem of the heavy capital involved by the abandonment of the old works and the erection of the new buildings and plant. In addition to his appointment with the Abingdon Gas Company, Mr. Ely was for more than twenty years Manager of the Radley College Gas-Works, which were established under his advice. Mr. Ely was a Freemason, and was initiated in the Evening Star Lodge in 1889. The funeral, which took place on Thursday, was attended by the Directors of the Company and other representatives of public bodies; the coffin being carried by the oldest employees at the gas-works. Deceased leaves a widow, three sons, and a daughter. His eldest son, Mr. B. Ely, is the Manager of the Riddings District Gas-Works.

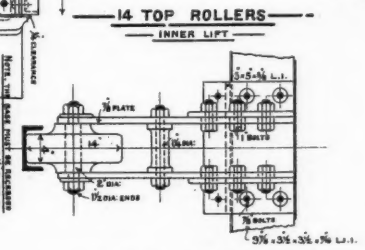
THREE LIFT GASHOLDER — SUTTON GAS-WORKS — No 5.

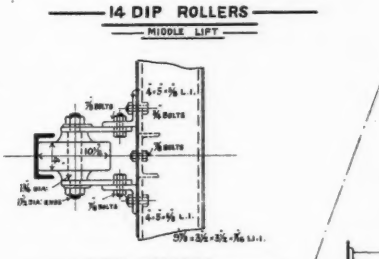
DETAILS OF STANDARD BASES, CUPS & DIPS, ROLLER CARRIAGES &c.

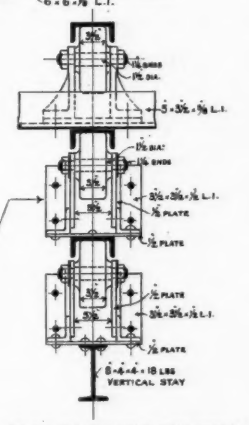


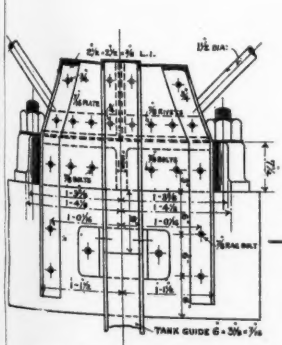


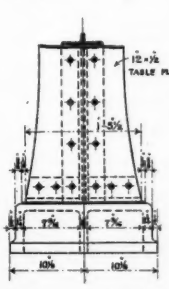


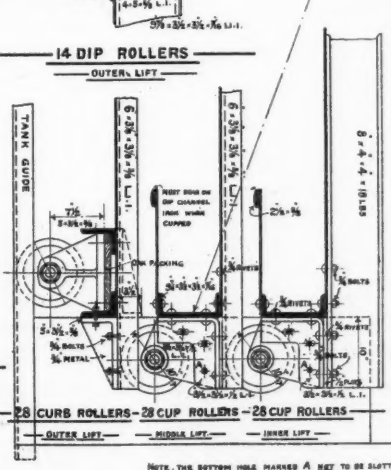


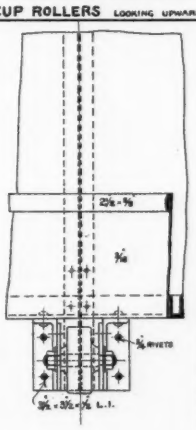


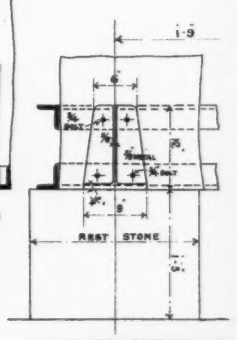












ALL ROLLERS TO BE ADJUSTED TIGHT AGAINST THE GUIDES

STRONG PLATES OF TOP CURB TO BE BULGED TO SPHERICAL SURFACE

MEANS TO BE PROVIDED FOR LUBRICATING THE AXLES OF ALL THE OUTSIDE ROLLERS

F. S. CRIPPS, A.M.I.C.E.
ENGINEER (27 GREAT GEORGE ST. WESTMINSTER)

NOTE. THE BOTTOM HOLE MARKED A NOT TO BE SLOTTED BUT TO BE DRILLED THROUGH CHEEK AFTER MARKING OFF IN PLACE. THE ROLLERS MUST BE ADJUSTED TIGHT AGAINST THE GUIDE WHEN DOING SO

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COMMUNICATED ARTICLES.

THE THREE-LIFT GASHOLDER AT SUTTON.

WITH REMARKS ON CONSTRUCTION.

By F. S. Cripps, Assoc.M.Inst.C.E.

III.—*The Holder* (*Continued*).

Top Curb.—The top curb is of the ordinary construction, consisting of a single angle iron and strong plates, the top and sides being well gusseted together in the angle, at every rafter and vertical stay. The strong plates forming the outer row of the top are butted together; the others are lap-jointed. The angle-iron is *faced* where it meets, so as to butt across the entire section; and the same remark applies to all the irons which butt together in curbs, cups, &c., throughout the holder.

It should be noted, when designing an untrussed gasholder, that, if it be found necessary to increase the weight of the inner lift in order to get sufficient gas pressure, there is no part of the holder into which the additional weight can be introduced to better advantage than in the top curb. The reason for this is that the distance the rollers leave the guides, due to compression of the top curb, is inversely proportional to the sectional area of the top curb. In other words, if the sectional area of the top curb be doubled, the amount by which the rollers leave the guides is halved.

Vertical Stays.—The principal object of the vertical stays is to support the weight of the top curb, carriages, and side sheeting; and, in the case of a trussed-top holder, the crown sheeting and framing. This support is only needed when the holder is at rest in the tank; because when it is floating, the vertical stays have little to do beyond stiffening the sides, the curb, and the cup. In the ordinary way they are made much stronger than necessary, particularly for holders with untrussed crowns. With an untrussed crown, the weight of the top is carried by a separate frame in the tank; so that in such cases the vertical stays have very little more to do than have the channel-guides in the other lifts. Not unfrequently gasholders are designed having enormously heavy vertical stays—sometimes in the form of box girders braced in all directions—very expensive, and out of all proportion to the work they are called upon to do. Why is this? It is sometimes done in untrussed gasholders to add weight, so as to secure sufficient pressure of gas before the inner lift cups; and in the case of very shallow holders, to get extra stiffness to resist the greater tendency of the inner lift to tilt before cupping. But it is to be feared that, in most cases where such extra strength is not needed, it has been due to a practice which has grown up by one man blindly following the designs of another; so that if one makes a mistake, the next assumes he has some reason for it, and does likewise—thus perpetuating the error.

The vertical stays should always be well gusseted to the top. In the Sutton gasholder (which has a trussed top), the vertical stays are constructed of a rolled joist, somewhat heavier and stiffer in section than the channel guides in the other lifts. The top end is rigidly attached to the top curb-plates, and the bottom end gives great stiffness to the cup.

Cups and Grips.—Ordinary channel cups have been adopted in preference to the bent plate cup, because they are very much stiffer in resisting horizontal pressure, resembling as they do a flanged girder with a straight web, rather than one with a doubled-up web plate. The ends of the channel-irons butt solidly together; and therefore they do not depend solely upon the shearing resistance of the rivets to resist horizontal thrust, as they would have to do in lap-jointed bent plates.

Instances might be given of bent plate cups on large holders, which are so springy under the weight of the hanging lifts, that the roller carriages on the grips being pulled down in front by the hanging weight and lifted behind, cause the grip rollers to be thrust hard against the standard guides with such force that the channel guides split and flake under the excessive pressure, and are worn out in a few years.

It has often been argued that the channel cup is more likely to leak at the riveted joints than a bent plate cup. But this contention is still open to question, as there is no more difficulty in riveting plates to the stout flanges of the channel-iron and making the joint sound, than in riveting two thick plates together, particularly when the joint in the two plates depends upon them being pressed to exactly the same curves so that they may come together properly. Undoubtedly gas-tight and durable cups can be made either way. It therefore resolves itself into a question of strength, stiffness, fitness, and economy. As regards the cost, there is little to choose between them; but as regards suitability and strength, there is no question that the channel cup is superior in every way. [This question was dealt with in the description of the Sydney gasholder, and was followed by a somewhat lengthy discussion in the "Journal"—lasting from February to the end of April in 1889.]

It may be pointed out that the bead iron on the cups is fixed on the *out*side of the cup-plates, because its object is not only to *stiffen* the edges of the plates, but to prevent any possibility of the plates rubbing against the sharp edges of the channel-guides. [It is only in badly made holders, however, that such a thing would be likely to happen; and it is generally caused by the cup plate being too big round, or too flimsy, so as to bend in and out. The bottom part of the cup cannot approach the guides owing to the cup-rollers.]

Channel-Guides.—The guides in the middle and outer lifts are securely fastened at the top and bottom only (not to each sheet in the height, as, being but a small holder, it is strong enough without it), and in such a manner as to lend the greatest possible support to the cups, grips, and curb.

[A very important point to notice is that the flanges of the channel-guides must be bevelled off at the top, as shown on Drawing No. 5. If this is not done, the bead iron on the cup might, by chance, when the holder uncups, lodge upon the sharp corners of the guide, and hook it up in one spot, and thus cause a collapse of the holder. If the cup-rollers were to break, this might easily happen. Very probably some failures of gasholders which have been put down to other causes were, if the truth were really known, due to this simple little thing. It is mentioned because it is by no means uncommon to meet with this defect in design at the present day.]

Method of Guiding.—The radial system of guiding has alone been adopted, as being the most direct-acting and decidedly the least expensive. The addition of tangential rollers would be a luxury altogether out of place in a holder of this size, and having the guide-framing the full height. It will be noted that the upper carriages are kept down as low as possible, not straining their necks aloft as they usually do. By this means, the leverage on the carriages, &c., is reduced, and the height of the guide-framing shortened.

The *Top Carriages* are very simply constructed, being free from angle-iron beads to stiffen the edges of the checks and similar expensive and unnecessary complications for a holder of this size. They are bolted down to the curb-plates in such a way as to prevent any possibility of gas escaping, or of water creeping under them and causing rust. Moreover, they can be taken off bodily without the bolts dropping to the bottom of the tank and the gas escaping.

The *Grip Carriages* on the middle lift have a broad base and are very short and direct-acting; thus relieving the grip of much bending strain. The angle-irons are bedded on canvas, which has been steeped in red lead, so as to make a gas-tight joint and exclude all water. Of course, there are washers and grummets under the nuts.

The grip carriages on the outer lift are on the *side;* thus enabling all the upper rollers to be kept down snugly. They are also in the best possible position to resist horizontal force. It necessitates the standard guide being in a line with the tank-guides—a point already referred to.

The *Cup-Rollers* are fixed *below* the cups, instead of being jammed in between the *side* of the cup-plate and the guide. It is true that putting the cup-rollers on the bottom of the cup necessitates making the tank a few inches deeper and setting the rest-blocks a little on one side of the guides; but this is amply compensated for in other ways. The old "friction rollers" are fast dying out, and "rubbing blocks" are never thought of, except as curiosities.

It will be observed from Drawing No. 5 that each cup-roller carriage is made to form a gusset or stiffening bracket to the cups, as it is not only riveted to the bottom of the cup but also bolted to the vertical bars behind; thus forming 28 rigid brackets round the circumference of each cup, and resisting any tendency to bend downwards under the weight of the hanging lifts.

The carriages on the grips, particularly those on the middle lift, perform a similar service to the grips.

[In passing, it may be noted that, with bent-plate cups and dips, it is not possible to make such a satisfactory arrangement of the roller-carriages. The most recent practice with bent grips is to mount a flat table on the round grip to take the base of the carriage, and which, as commonly designed, is without doubt the worst trap for catching water to rust the grips that could possibly be devised.]

Adjustment in all carriages is obtained by slot holes. As, however, the cup-rollers are not to be got at when the holder is in use, they are adjusted tightly against the guides, and the final hole is marked off in position and drilled to suit. Then there can be no shifting backwards after once fixing.

All rollers have *solid* webs. To cast holes in the webs between the spokes is very dangerous, as when so made they very frequently crack and break from contraction strains.

Rest Brackets, &c.—It is sometimes found that the *outer* lift of gasholders will not stand truly erect in the tank, the sheeting appears to buckle, and the grip to lean inwards, in places, towards the next lift, generally opposite the standards. This may, of course, be due to general weakness or insufficient rest-blocks under the bottom curb; but it is more frequently due to the manner in which the weight is taken. In the other lifts, the cups form a broad and flat base to each; but the bottom curb is comparatively narrow.

In the Sutton holder, therefore, the bearing of the bottom curb has been increased by attaching cast-iron rest-brackets inside, so as to bear upon the rest-blocks in the tank, and prevent any tendency of the sides to fall inwards due to the direction of the weight of the upper parts when at rest.

In concluding the description of the Sutton gasholder, it should be stated that only such points and details as may be of some interest, or which serve to illustrate the principles governing the design of such structures, have been alluded to in the foregoing

pages; and it should be remembered that these remarks as to strength and design generally are more particularly applicable to *fully guided* gasholders. For holders only partly supported by guide-framing, or guided by special methods, or of the composite order, other considerations step in.

Many of the things mentioned may have appeared obvious and trifling to the uninitiated. But to those acquainted with the manufacture and erection of such structures, it is the reverse, for they know but too well that it is in these *little* things, to which attention has been drawn, designers most frequently go astray; and it is in these little things, too, where the economy or extravagance makes itself most felt in the construction.

PHOTOMETRIC STANDARDS.

By W. GRAFTON, F.C.S., of Beckton.

(*Continued from p.* 1378.)

Having determined the amount of light passing through the 2·15 inch slot, it was next desired to see the influence of temperature upon the carburetter, and the effect on the quality of the flame due to extra enrichment. These experiments entailed a good deal of labour; and to avoid errors, they extended over some months. Extreme care must be taken to see that the air is practically pure.

The carburetter was placed in a bath, and covered with finely broken ice until a steady temperature of 32° Fahr. was maintained. The air supplied to the carburetter necessary to carry pentane vapour to give a 3-inch flame was measured and corrected to normal temperature and pressure. The rate of air was determined over a period of five or more minutes. The amount of light was determined by another Dibdin standard set at a temperature of 60° Fahr.—in fact, the room temperature was also 60°. As soon as the observations and other data were taken, the ice was replaced by water at 40°; allowing several minutes to settle down. Then readings were taken after adjusting the flame to 3 inches; in this way going through the same operation at every stage of temperature up to 94°.

The results of twenty series of such experiments are shown in Diagram A, which clearly proves that, as the pentane vapour increases, the quantity of air and light emitted through the slot decrease. At 96° Fahr., no air is used at all; there being more than sufficient pentane evaporated to maintain the flame. Above this point it is not safe to work, as the light commences to jump, due to condensed vapour in the tube. The amount of air used in relation to pentane vapour is shown, and also expressed in percentages from 32°, which gives striking proof of the varying amount of pentane vapour present in the outflowing carburetted air (Table II.).

TABLE II.—*Quantity of Air required to Give a 3 Inch Flame from a Dibdin Carburetter.*

Degrees Fahr.	32	40	50	60	65	70	75	80	90	94	95
Percentage quantity of air used	100	77	58	38	28	26	21	15	6	1·5	0

From these experiments, it cannot be expected that the light would remain constant. Apart from the writer's idea on the subject, Professors Lewes and Smithells have given able evidence on the theory of luminosity of flames to upset such a statement that the vapour may vary to the equivalent of 40°, and yet give the same amount of light.

The Dibdin burner is subject to all the influences attending ordinary argands, and in some respects more so. The variation between the working temperatures is equal to 40 per cent. of air, which means that pentane vapour must take its place. The air entering to support combustion does not increase to anything like this amount; and consequently the flame is not so incandescent as at the lower temperatures. If the amount of hydrocarbon vapour had remained the same, then the light would be but slightly altered.

Seeing, then, that the quantity of air used to convey the vapour of pentane varies with the temperature, analysis of the carburetted air was resorted to for further proof that the quantity of pentane also varied with the temperature. Good paraffin was employed to absorb the pentane vapour, this giving by far the most rapid and accurate results. 100 c.c. of pentane-air was acted upon; care being taken to see that the temperature of the water and the surrounding atmosphere was the same. In making these experiments, the same quantity of air was always passing through the carburetter; for if the air be not allowed to flow,

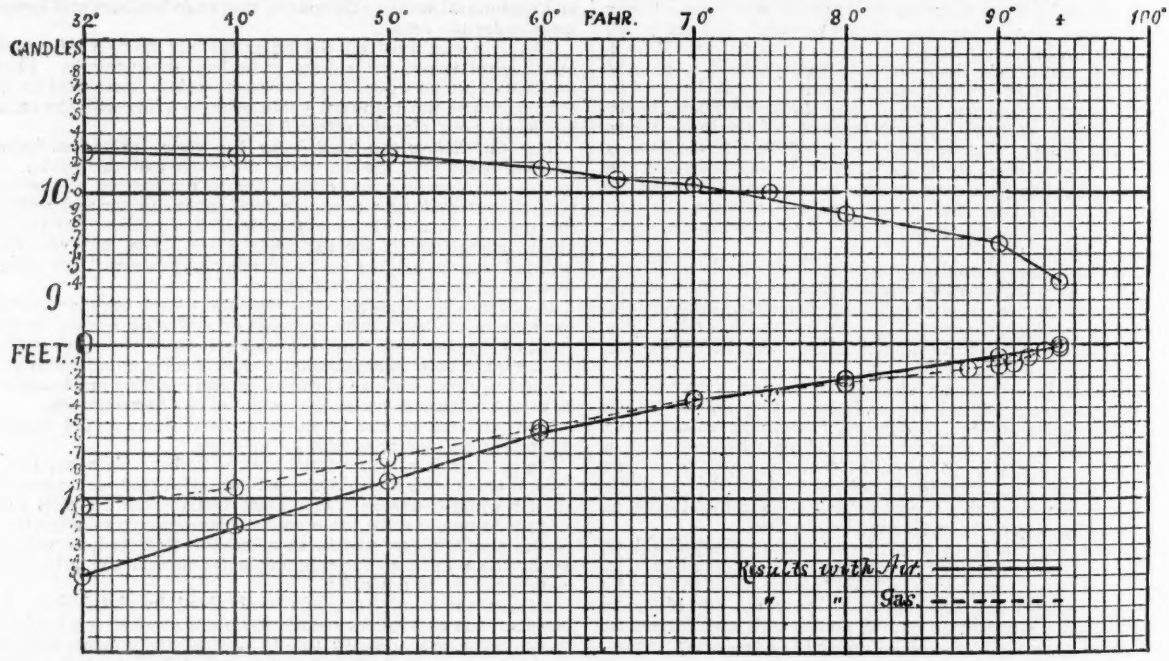


DIAGRAM A.

accumulation of vapour in the carburetter occurs, and we do not get a like sample of the carburetted air as is used in practice. The rate of air chosen was the quantity used by the standard at a temperature a little below 60°. It was regulated on the inlet of the meter, and the cock was not touched. So that for the experiments at 60° and 81°, practically the same quantity was passing as at 57°. Repeated trials showed that the rate was the same; and in all cases the outlet-cock of the carburetter was wide open. There is a good deal of difference between having only a little pentane in the carburetter, and having it three-quarters full or full (just so that air will pass).

A Methven carburetter was experimented with, and similar results found; so a carburetter was devised by employing thin rough wooden partitions instead of metal ones. This gave more satisfactory results as regards quantity of pentane volatilized. The wooden partitions tended to increase the evaporative surface at low temperatures; while at the same time they did not influence the temperature of the carburetter so much as the metal ones. This is very conspicuous at the higher temperature; the wood not being a good conductor of heat, prevented the body of liquid being heated quite so much, and consequently less pentane is volatilized.

The carburetters were not the same size and shape, but as under:—

Dibdin carburetter, 8 inches diameter by 2 inches deep, with an air-travel in contact with pentane of 54 inches by 1 inch wide, spiral course between metal walls.

Methven carburetter, 6 inches square by 1¾ inches deep, with an air-travel in contact with pentane of 78 inches by about ⅜ inch wide, to-and-fro course between metal walls.

Grafton carburetter, 5 inches square by 2½ inches deep, with an air-travel in contact with pentane of 55 inches by about ⅜ inch, to-and-fro course between wooden walls.

Each carburetter containing 28 ozs. of pentane, gave the following percentage results of pentane vapour in air:—

Title of Carburetter.	50 degs. Fahr.	60 degs. Fahr.	81 degs. Fahr.	Increased from 50 to 81 degs. Fahr.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Methven	28·4	36·4	53·2	87·3
Dibdin	26·6	37·7	51·8	94·7
Grafton	29·5	39·1	48·6	64·7

Considering the large travel in the Methven carburetter, the results are more satisfactory than by the Dibdin carburetter.

Analyses of Carburetted Air with Different Quantities of Pentane in Carburetter.

DIBDIN CARBURETTER.

Temperature of Room, 60°; bar., 30·40, January, 1896.

Pentane Added and in Carburetter.	Percentage of Pentane Volatilized and Carried by the Air.	Percentage of Air Used as Carrier.	Air Passing through Carburetter.
			Cubic Feet.
15 c.c.	30·7	69·3	0·675
+ 50 ,,			
65 ,,	32·5	67·5	,,
+ 100 ,,			
165 ,,	35·0	65·0	,,
+ 200 ,,			
365 ,,	37·0	63·0	,,
+ 450 ,,			
815 ,, ¾ full	37·7	62·3	,,
+ 355 ,,			
1165 ,, full	36·0	64·0	,,
Temperature of Room, 50°; bar., 30·66, Feb. 5, 1896.			
30 c.c.	20·6	79·4	0·675
+ 100 ,,			
130 ,,	22·4	77·6	,,
+ 200 ,,			
330 ,,	22·3	77·7	,,
+ 450 ,,			
780 ,,	26·6	73·4	,,
1165 ,, full	25·0	75·0	,,
Temperature of Room, 81°; bar., 30·58, Feb. 7, 1896.			
30 c.c.	40·7	59·3	0·675
130 ,,	41·2	58·8	,,
330 ,,	44·2	55·8	,,
780 ,,	51·8	48·2	,,
1165 ,, full	52·2	47·8	,,

METHVEN CARBURETTER.

Temperature of Room, 60°; bar., 30·34, Jan. 24, 1896.

Pentane in Carburetter.	Depth of Pentane.	Percentage of Pentane Volatilized and Carried Over.	Percentage of Air Conveying Pentane.	Air Passing through Carburetter.
	Inches.			Cubic Feet.
15 c.c.	..	28·2	71·8	0·675
65 ,,	¼	29·8	70·2	,,
165 ,,	½	30·2	69·8	,,
365 ,,	¾	31·9	68·1	,,
815 ,,	1 1/10	36·4	63·6	,,
Temperature of Room, 52°; bar., 30·65, Feb. 6, 1896.				
30 c.c.	..	21·1	78·9	0·675
130 ,,	..	23·0	77·0	,,
330 ,,	..	26·0	74·0	,,
780 ,,	..	28·4	71·6	,,
Temperature of Room, 81°; bar., 30·60, Feb. 7, 1896.				
30 c.c.	..	43·5	56·5	0·675
130 ,,	..	44·2	55·8	,,
330 ,,	..	45·7	54·3	,,
780 ,,	..	53·2	46·8	,,

GRAFTON CARBURETTER.

Temperature of Room, 60°; bar., 30·34, Jan. 22, 1896.

Pentane in Carburetter.	Depth of Pentane.	Percentage of Pentane Volatilized and Carried Over.	Percentage of Air Conveying Pentane.	Air Passing through Carburetter.
	Inches.			Cubic Feet.
15 c.c.	..	30·5	69·5	0·675
45 ,,	⅛	32·1	67·9	,,
90 ,,	¼	34·7	65·3	,,
195 ,,	½	38·3	61·7	,,
395 ,,	1	37·8	62·2	,,
820 ,,	2½	39·1	60·9	,,
Temperature of Room, 50°; bar., 30·66, Feb. 5, 1896.				
30 c.c.	..	21·0	79·0	0·675
130 ,,	..	22·6	77·4	,,
330 ,,	..	23·5	76·5	,,
780 ,,	..	25·1	74·9	,,
Temperature of Room, 81°; bar., 30·60, Feb. 7, 1896.				
30 c.c.	..	37·8	62·2	0·675
130 ,,	..	40·8	59·2	,,
330 ,,	..	45·4	54·6	,,
780 ,,	..	48·6	51·4	,,

(*To be continued*)

TECHNICAL RECORD.

SOCIETY OF ENGINEERS.

A Visit to the Fulham Gas-Works.

Last Tuesday a number of the members of the Society of Engineers paid a visit to the Fulham station of The Gaslight and Coke Company. They were very courteously received by the Engineer (Mr. H. Iago), who, with his two Assistants (Messrs. H. S. Reeson and A. H. Solomon), were painstaking in making the visit an instructive and enjoyable one. The Fulham works are extremely interesting from an engineering point of view, as there there is to be seen a striking combination of old and modern methods of construction. Several relics of the Imperial Company's days are still in operation; and some of them look good for many more years' service. The ornate work about the old holders, purifiers, and other parts of the apparatus must have appeared strange to some of the younger visitors, who have received their training in these days of economical construction. From the information given by Mr. Iago and his Assistants, we gathered that the works cover an area of 26 acres. The maximum make of gas per day is 9 million cubic feet; and the maximum consumption of coal, 900 tons. The method of dealing with the coal on its delivery at the works attracted considerable attention. The quantity received is 130,000 tons a year; and it is unloaded by Hone's single-chain grabs, which have a capacity of 1 ton each, and are capable of lifting 45 tons per hour. The coal is deposited in bunkers, whence it is distributed to the several retort-houses by small waggons. When storing coal in the open, it falls down shoots from the bunkers into a conveyor of the push-plate pattern, and is carried along to the storage-ground, where it is dropped from a shoot at the end of the conveyor into small waggons, which are run and tipped so as to form a heap of an average depth of 10 or 12 feet. The conveyor is an American invention (Dodge's patent), and was supplied by the Chain Belt Engineering Company, of Derby. The cost of unloading and taking in coal to the heap is less than 4d. per ton; from the heap to the retort-house, slightly more. We have not had an opportunity of seeing this conveyor in actual work; but it was temporarily running on Tuesday during the visit. In one respect at least, there seemed to be room for improvement, and that is in a modification of the dolorous screeching to which the chains give vent. The total coal storage on the works is 30,000 tons—14,000 tons in the retort-houses, and 16,000 tons in the open—which is equal to six weeks' consumption in the busy time. The retort-houses, of which there are six, have a capacity of 9 million cubic feet per 24 hours. They contain 760 retorts, 20 feet long, and are heated by generator furnaces, which require about 20 per cent. of the total make of coke for fuel. The visitors had an opportunity of watching the operations of drawing the retorts and re-charging by scoops; and also the clinkering and feeding of the furnaces. In the exhauster-house, much interest was evinced in the explanations given as to the use of three of the exhausters for drawing gas from Beckton. As to other parts of the plant, it was seen that the condensers are in two sections—consisting of 42 pipes, 40 feet high. The scrubbers are also in two sections. There are nine in all; and they are 47 feet high. There are 24 purifiers, 40 ft. by 35 ft. by 6 ft.; and, in addition to slaked lime and oxide, Weldon Mud is employed in the purification. There are two station meters, of a capacity of 180,000 cubic feet per hour each; and there are six gasholders, of a united capacity of 10,250,000 cubic feet. The tar and liquor are freighted in tank-barges to the Company's products works at Beckton. The workshops, which are well fitted with modern appliances, were also inspected. Before leaving the works, the visitors cordially thanked Mr. Iago for the kind attention he and his Assistants had shown them. The party then proceeded to the Earl's Court Exhibition, where they inspected and journeyed round that marvellous engineering work the Great Wheel; and in the evening they dined together at the Victoria Restaurant in the Exhibition. The success of the outing was in great measure due to the admirable arrangements made by the Secretary (Mr. G. A. Pryce Cuxson), and to his well-known insistence on promptness in the matter of time.

THE DE BROUWER-ROUGET COKE-CONVEYOR AND RETORT-CHARGER.

Readers of the "JOURNAL" are acquainted with the appliance devised by M. De Brouwer, of Bruges, for the mechanical removal and quenching of coke; and attention has recently been specially directed to it in the papers read by Mr. E. A. Harman and Mr. Edward Drory before the Society of Engineers and the Institution of Gas Engineers respectively (*ante*, pp. 1312, 1449). As a company has been formed to introduce the conveyor into this country, opportunity will probably soon be afforded of practically testing its merits, which have already been fully recognized and appreciated on the Continent, where several installations are in operation. The general arrangement of the appliance was shown in the "JOURNAL" for Jan. 18 last (p. 127); and it may be briefly described as follows: In

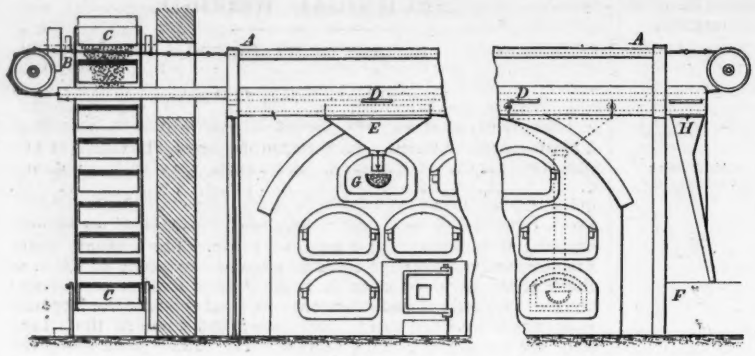


FIG. 1.

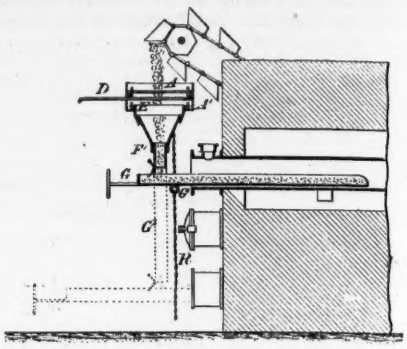


FIG. 2.

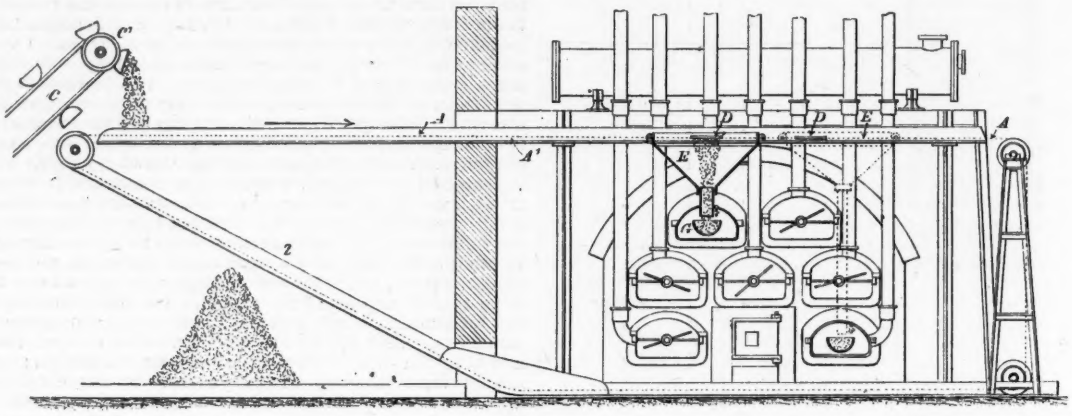


FIG. 3.

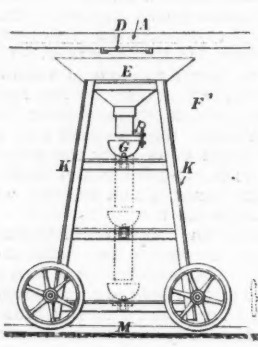


FIG. 4.

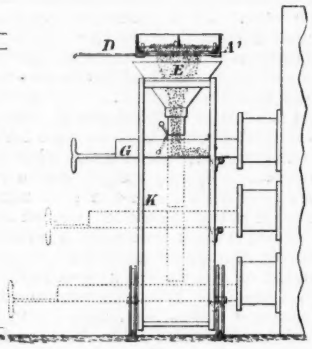


FIG. 5.

front of the retorts there is a metal or masonry channel into which the coke is drawn on to two endless chains whereby it is carried up an incline to a horizontal distributor, and dropped on to the heap. The chains in their return pass along the entire bench at a point a little above the top retorts, and then descend to the channel to take up more coke. It will thus be seen that the chains, in making the circuit, have, so to speak, a spell of useful work followed by a period of comparative inutility. While watching the conveyor when in operation, and admiring its simplicity, it occurred to M. Rouget that the return movement of the chain might be utilized for conveying coal to the charging-scoop. He promptly put his idea into practical shape, and described the arrangement at the last meeting of the Société Technique du Gaz en France. An extract from his paper was published in "Le Gaz" for last month; and from this and the plates accompanying the companion publication, "Le Constructeur d'Usines à Gaz," we are to-day able to give the following particulars in regard to the combined appliance.

It will first be most convenient to describe M. Rouget's retort-charging system, shown in figs. 1 and 2 of the accompanying illustrations—the former being an elevation and the latter a cross section of a bench. A is a conveyor, upon one of the extremities of which the coal is deposited by means of the chain of buckets C. The conveyor is provided at different points, corresponding to the retorts, with traps D, allowing the necessary quantity of coal to fall into the funnel-shaped receptacle or hopper E, the size of which is proportionate to the charge. This hopper may be moved upon the angle-irons A^1 placed beneath the conveyor. It is closed at the bottom by a flap-valve F^1 operated at will. The charging-scoop G is supported and guided by a friction-roller G^1. The movement of the conveyor is continuous; but the opening of the traps is intermittent. When the hopper is full, the surplus coal passes along, and falls down the shoot H into the waggon F, by which it may be taken again to the stack. The scoop is suspended from the hopper by a pulley, which allows it to be brought to the level of any of the retorts.

The system devised by M. Rouget is combined with that of M. De Brouwer in the manner clearly shown in fig. 3; all that is required being the fixing of a base-plate furnished with traps upon the angle-irons which guide the chains. Under these conditions, the charging and drawing operations can go on together, if the chain of coal-buckets is placed at the discharging end of the coke-conveyor *Z*. Instead of the hopper and scoop being supported from the angle-irons of the conveyor in the way already mentioned, they may be moved along the floor of the retort-house by means of a carriage running upon wheels, as shown in figs. 4 and 5—the former being a front view, and the latter a section of the carriage K. Experience will show whether or not the two operations of charging and drawing can be combined; but a saving of labour and wear and tear would result if this were practicable. At all events, by the arrangement above described the men are relieved of the heavy work of raising the scoop to the third, or even to the second, row of retorts, and of carrying the coal to the fronts of the retorts and filling the scoops. This relief would result in considerable economy, and enable a manager to recruit his ranks more easily and at less expense. At Fontainebleau, with one coke-conveyor, stokers do a charge in half the time required under the old system. With M. Rouget's arrangement, the retorts are charged by stages, and not singly; thus avoiding the lengthening of the hopper during the process, and preserving the temperature of the bench by the opening of fewer retorts at a time.

WESTERN (U.S.A.) GAS ASSOCIATION.

Annual Meeting at Detroit.

The Twenty-first Annual Meeting of this Association was held on the 18th, 19th, and 20th ult., under the presidency of Mr. JAMES T. LYNN, of Detroit. An official welcome was given to the members by the Hon. William C. Maybury, Mayor of the city, and acknowledged in suitable terms by Capt. W. H. White of New York.

The President, in his Inaugural Address, first alluded at some length to the past of the Association, which was originated at a meeting of 28 persons held at St. Louis in September, 1878. The past year had been one of prosperity and satisfaction to the gas industry generally, though some had suffered a reduction (which would be only temporary) by the economy caused by the introduction of incandescent gas-lights. This could be met by additional canvassing and advertising, which would soon convert the apparent loss into a positive gain. The demand for gas-stoves was in the ascendant, which was a satisfactory

feature, as the placing of a fuel-meter was an assurance of a constant consumer. The Welsbach gas-burner, as applied for public lighting, had proved not only that gas was much cheaper than electricity, but that it was capable of giving greater satisfaction. Some years ago it was supposed that gas had been finally banished from the streets; but it was steadily returning, and with assured success. All the methods of lighting on this system that had come under his personal observation had proved decidedly superior to any other style of artificial illumination. The important part that incandescent burners were taking in the work of artificial lighting seemed to indicate that the time when it was necessary to manufacture a high quality illuminating gas in order to compete with electricity was passing away, and that the most successful means of competing with other means of illumination was incandescent heat rather than primary light. In referring to cheap fuel gas, he said that the extent of its failure as a commercial undertaking had been clearly portrayed at the last meeting; and the conditions remained unchanged—in fact, time seemed only to emphasize the failure of such projects. The prices now offered for tar were so low that he considered all large companies should install plant for the purpose of tar distillation. The advocates of municipal ownership of gas undertakings had promised cheaper gas and lessened taxation; but there was no instance on record to show that these promises had been fulfilled.

Mr. G. H. Harper, of Altoona (Pa.), read a paper on the "Enrichment of Coal Gas," prepared with the view of collecting and summarizing the known facts relating to this important question. Four methods had been commercially applied for this purpose—viz., the carburetted water gas system, the use of cannel or oil in ordinary retorts, and the application of volatile hydrocarbon vapours at the outlet from the gasholder. With regard to the first, it might be said that, so far as their own country was concerned, production rather than enrichment was the primary object, as its well-known advantages rendered it preferable to the retort system. The use of oil in ordinary retorts was usually of a somewhat makeshift character, and could scarcely be said to have attained the dignity of a system. Descriptions of the Peebles oil-gas process and the Maxim carburetter were given; and this was followed by some general considerations as to the properties of methane, ethylene, acetylene, and benzene. Quoting figures from Brown's "Directory of Gas Companies" for 1894 (the latest issue), the author arrived at the conclusion that over 70 per cent. of the gas distributed and sold in the United States and Canada is carburetted water gas. Attention was directed to the enriching of 16-candle gas to the extent of 2 candles, and a table was exhibited showing that this could be done (*a*) by the addition of 11·57 per cent. of 23-candle water gas; (*b*) by the addition of 2·7 per cent. of 60-candle oil gas made by the Peebles process; (*c*) by the addition of benzol vapour in the proportion of 1 gallon of the fluid evaporated to 5500 cubic feet of gas, and a gallon of carburine similarly treated would serve for 2400 cubic feet, and petroleum of ·700 sp. gr. for 1800 cubic feet of gas. The distinction between "photometrical value" and "enrichment value" was explained; the results arrived at by the late Mr. John Methven at Beckton being quoted, as published in the "Journal." The author said that the brilliant researches of Mr. William Young and Professor Lewes, in his judgment, were sufficient to exclude acetylene from consideration as an enriching agent. A brief reference was made to the researches of Mr. C. Stafford Ellery and of Mr. Isaac Carr on the use of coal tar for enriching. In considering the value of any enriching process, it was necessary to bear in mind not only that a large proportion of gas is used for purposes other than lighting, but that a gradually increased proportion of the amount consumed for lighting was burnt through appliances in which the illuminating value of the gas, as understood by the photometer, was of small moment. All enrichment, to be of any use to the consumer, must be of a permanent character; and it did not follow that a gain of 2 candles, as indicated by the argand burner at the photometer, insured an actual gain to this extent in the flat-flame burners used by the consumer. Considerable difference of opinion prevailed as to the procedure at the photometer, and whether it really indicated the fair value both of the crude and of the enriched gas. The conditions of the test might possibly favour one more than the other. Professor Lewes had remarked "that a considerable amount of vagueness existed as to what is meant by the illuminating power of a gas;" and he defined it "as the highest illuminating effect that can be produced from the gas without the aid of regeneration or artificial air supply, other than that created by the flame itself." The author concluded by showing, from the opinions of five well-known authorities, that the questions of enrichment, the relative value of enrichers, and the value of enrichment to the consumer, so far as they can be determined by existing photometric methods, are in a somewhat chaotic condition.

The discussion was commenced by the reading of a communication from Mr. W. W. Goodwin, of Philadelphia, referring to a paper on the enriching properties of acetylene, which he read before the Asssociation two years ago. He had made over 1000 tests in order to arrive at the percentage of acetylene that would give the best increase of power with an ordinary 14 to 16 candle gas; and he had put the results into diagram form. He used an ordinary 60-inch photometer with two standard candles, and either a Peebles flat-flame or a Sugg "D" argand burner. He devised a special form of generator for the acetylene, which was fully described, as also was the arrangement for obtaining either a 4, 6, 8, or 10 per cent. mixture of acetylene and ordinary gas. The average results for the ordinary gas (unmixed) were 16·18 candles; those with a 4 per cent. mixture of acetylene, 23·28 candles; with a 6 per cent. mixture, 27·56 candles; with an 8 per cent. mixture, 28·84 candles; and with a 10 per cent. mixture, 31·59 candles. The individual tests showed a considerable degree of variation, comparing one with another. Mr. A. S. Miller said that in his experience the photometrical and enriching values of water gas of not over 30-candle power were about the same; and a mixture of coal and water gas figured out at about the mean of the respective values. He took exception to the statement that a 2-candle gain at the photometer might mean only a fraction of a candle to the consumer. It might mean considerably more than 2 candles, because flat-flame burners gave better results with rich than with poor gas. The assumption was unfair as against the high-power gas; and he quoted some figures in support of this view, which also showed that high-power gas was much more favourable to small burners, than low-power gas. He thought the paper indicated a want of confidence in the photometer that was not warranted. The photometer was not perfect; but it could be relied upon to within 1 per cent., if honestly and properly manipulated. It was a mistake to let the idea go forth that gasmen had no confidence in their methods of working. Dr. Moss did not quite approve of the statement that illuminating value is not of very much consequence. The comparative values of photometrical and enrichment value would vary according to the quality of the gas; and the figures quoted applied only to the one particular gas, and could not be treated as the basis for a general rule. He quite agreed that the photometer was a reliable instrument. As to the value of the gas at the photometer and at the consumer's burner, it was the consumer's own fault if he did not provide the most suitable burners; and the quality of the gas should not be charged with any deficiencies in this respect. Mr. A. C. Humphreys also upheld the reliability of the photometer, and said that the difference between photometrical and enrichment value, which had only been observed with very rich gases, was simply due to the fact that there was no burner suited to the proper combustion of such gases. With care in selecting suitable burners, the value of a mixture was not far from the mean of the value of the components. In treating various gases at the photometer, it was very important to consider the characteristics of each. Mr. Egner thought the principle of the photometer was right; but differences occurred with the candles. He had known a variation of as much as 4 candles in the indicated value of the gas from this cause; the rate of consumption of sperm remaining regular. Mr. Forstall thought that due care in seeing that the candle was burning properly would greatly minimize inaccuracies of the kind just mentioned. Mr. Thompson remarked that it was pretty well understood that paraffin candles burning with a flame 46 mm. in height gave a more uniform emission of light than the sperm candle at 120 grains per hour.

Mr. Harper, in replying, admitted that his determinations were inconclusive, and said he had shown in the paper the reasons why they must necessarily be so. Mr. Miller had challenged his tests, and asserted that they did not agree with similar tests made by others. Every man had a right to stand by his own tests; and he had made a large number, and felt inclined to stand by them. Some speakers assumed that he had attacked the photometer; but they were wrong. He had only shown the effect of difference in methods of burning gas, as illustrated by extracts from the statements of the best authorities; and he contended that there was no uniform method of testing the photometric value of various gases. One used a flat flame for a certain quality of gas, and another an argand. It was well known that, with reasonable care, a photometer would afford accurate readings.

A paper on "The Use of Gas for Purposes other than Lighting," was read by Mr. C. W. Blodges, of Brooklyn (N.Y.). While it had always been understood that the primary object of gas was for illumination, he thought the time had now come when its use for other purposes could be so extended, by proper push and energy, as to largely reduce or eliminate the disparity existing between heat, light, and power. Great improvements had been made in the construction of gas stoves, furnaces, and engines; but he thought that many gas engineers, even now, had not done anything, in a regular systematic way, towards introducing these appliances. One reason for this was that many were satisfied with a general all-round increase. Further examination might show that the increase was due to one line only, and that there was a decrease in other branches. He illustrated this point by giving details of an undertaking which recorded an increase of 259 per cent. in ten years. But further examination showed the consumption per consumer had fallen from 29,000 cubic feet in 1887 to 20,000 cubic feet in 1897. Had it not been for the large increase of day business, due to the introduction of stoves, there would have been an actual decrease. The new business had necessitated a large increase in expenses for services, meters, and office work. These figures showed that prompt and energetic measures should be taken in the direction of securing a use for gas for other than lighting purposes. The advantages of gas cooking-stoves need not be recapitulated to gas managers; but steps should be taken for making them equally

well known to every consumer. The figures quoted also showed that the gas-stoves were only used during the summer months. If a good gas water-boiler and a means of heating the kitchen in the winter could be found, they would be used all the year round. The cooking consumption might therefore quite equal half the total business done. The introduction of gas-engines had been neglected or ignored by most gasmen. For engines under 100-horse power, gas was cheaper than steam by 10 to 50 per cent. One of the uses to which gas-engines could be put was the working of electric lighting machinery, as it had been proved that electricity could be generated in this way at half the price charged by the supply companies. Gas was also capable of being made efficient as a heating agent; but how many gas companies had tried to push it as such? One great defect was that the executive officers and directors of gas companies did not set the example in their own houses and places of business, in the use of gas for these purposes, that they ought to do.

Mr. E. G. Cowdery commenced the discussion by saying that he fully agreed with the conclusions arrived at in the paper. He proceeded to examine the increase of sales in another locality on the lines there indicated, defining day consumption as that between 6 a.m. to 6 p.m., and night consumption as the remainder of the 24 hours. The total increase over seven years was 100 per cent.—for day consumption alone 207 per cent., and for night consumption only 50 per cent. But the summer day increase was 550 per cent.; while that of the winter day was only 125 per cent. There was a difference between sale per consumer and sale per meter. The last-named condition was affected in his case by the introduction of separate meters for fuel purposes. The sale per consumer was 31,500 cubic feet in 1887, and 38,000 cubic feet in 1897; and in the latter year the sale per meter was 22,000 cubic feet for lighting, and 24,000 cubic feet for fuel meters. The day output was nearly 50 per cent. of the whole; and most of the cooking-stoves were used throughout the year. The fuel sales were 38 per cent. of the whole. He was successfully introducing gas-engines; and last year his engine consumption was equivalent to 72 engines at 24,300 cubic feet each. The number of purposes for which the engines were used were fully enumerated. Large quantities of gas were also employed for heating laundry irons, brazing, soldering, linotype machines, roasting coffee, and many other technical purposes. He sent a man out among the manufacturing establishments to devote his full time and attention to finding out new uses for gas for fuel purposes. With regard to the employment of gas for warming, he had made a practical working experiment during the past winter, and found that, at the current prices, for coal the value of gas for fuel was 1s. 8d. per 1000 cubic feet. Mr. Forstall gave details of a similiar experiment extending over two years, which gave 20,000 cubic feet of gas = 1 ton of coal, or about the same as Mr. Cowdery's results. But he noticed that the increase of consumption during cold weather was very large; and the use of many such furnaces would therefore in practice prove very troublesome, and would scarcely admit of any inducement in the way of a special price being offered for this line of business. Mr. Egner was disappointed at finding no mention in the paper of the use of gas for motor cars. It was so employed in England and Germany, where they had proved that cars seating 25 persons could be driven at 15 miles an hour, if desired, with an average consumption of 30 cubic feet of gas per mile. He quoted several statistics from the annual report of a street railway worked on this system in Germany. Mr. T. D. Miller said that at Dallas (Texas) the sales per meter were 33,000 cubic feet in 1892 and 22,000 cubic feet in 1897. The day consumption was greatly affected by conditions of climate and temperature.

(*To be continued.*)

THE DECOMPOSITION OF GAS OIL, PHENOL, AND CREOSOTE BY HEAT.

(*Continued from p.* 1386.)

The Experiments with Phenol.

Pure crystallized phenol (carbolic acid) melting at 105·8° Fahr., and boiling at 352·5° to 359·5° Fahr., was melted in the hot water funnel, and run in a thin stream into the gasification tube. Gasification proceeded regularly for some time, but finally ceased owing to the separation of carbon in the tube. In 2 hrs. 50 min., 75 grammes of phenol were gasified, and 48,606 c.c. of gas were obtained, which corresponds to a make of 4·7 c.c. per second. The gas at the start was of a dirty white colour, but later was colourless. The weight of a litre of the dry gas was 0·5618 gramme. After elimination of the air present in it, the gas had the following composition in volumes per cent.: Ethylene and homologues (C_nH_{2n}), 1·3; carbonic oxide, 30·8; hydrogen, 58·9; methane and other paraffins (C_nH_{2n+2}), 9·0. The tar was found exclusively in the flask next to the gasification tube, and amounted to 13 grammes. It was a thin liquid, coloured by suspended carbon. On fractional distillation, it yielded 2·7 grammes of distillate coming over below 248° Fahr., and the residue showed on standing no indication of separated phenol; so that evidently no considerable amount of raw material had escaped gasification. The paraffin oil in the absorption vessels yielded 4·8 grammes of distillate, which was mixed with that from the tar. From the mixture there was obtained 3·32 grammes of benzene. The mixture contained traces of phenol, which prevented the estimation of the olefines by means of bromine. Finally, the chief product of the gasification was the separated carbon, which choked the tube and was impermeable to the gas. It amounted to 21·8 grammes, but was not accurately determined; and the loss shown in the following table is chiefly unestimated carbon. The table includes the results of a second test, in which 44 grammes of phenol were gasified in 3 hrs. 50 min., and afforded 21,695 c.c. of gas weighing 0·6113 gramme per litre.

Products Obtained from 100 *Parts by Weight of Phenol* (*Carbolic Acid*).

—	First Test. Parts.	Second Test. Parts.
Ethylene (C_nH_{2n})	1·02	0·98
Carbonic oxide	24·89	21·22
Hydrogen	3·41	2·74
Methane (C_nH_{2n+2})	4·16	0·81
Benzene	4·42	20·90
Carbon	29·06	2·30
Tar and other unexamined products	23·60	44·10
Loss	9·44	6·95

Both tests show, in the main, similar results. The chief products are carbon, carbonic oxide, and hydrogen; and they therefore agree with the following equation:—

$$C_6H_6O = CO + 6H + 5C.$$

According to this, 100 parts of phenol should yield 29·78 parts of carbonic oxide, 6·39 parts of hydrogen, and 63·83 parts of carbon. In the two tests there were obtained the following percentages of the theoretical yields of each of these products: Carbonic oxide, 83·5 and 71·2; hydrogen, 53·44 and 42·9; carbon, 29·7 and 32·7. From these results it may be concluded (1) That phenol is completely decomposed at a temperature between 1300° and 1470° Fahr.; (2) that the phenol molecule is broken up substantially in accordance with the above equation; and (3) that the formation of benzene by the rupture of the phenol molecule is slight.

In addition to the chief decomposition products, small quantities of hydrocarbons occur, owing to combinations between the carbon and hydrogen, which otherwise are liberated when the carbonic oxide is formed. It is not necessary to assume, in order to explain the formation of these compounds, that unsaturated groups such as acetylene are first formed by scission, and afterwards combine with hydrogen. The assumption would indeed be a hazardous one, for Haber and Oechelhaeuser showed that very little ethylene was formed from acetylene at 1300° to 1470° Fahr.* The following explanation appears to be more acceptable. The loosening of the atoms in the molecule permits a transference of hydrogen atoms; and this leads to the production of methane and olefines. In the moment of dissociation, the atoms are in an unstable condition, and pass into combinations into which they would not enter through the simple transpositions which could occur at lower temperatures. This conception of the course of the changes is not contrary to the ideas of chemists, though it does not agree with the hypotheses of the ordinary reactions of organic chemistry. According to these, the general disposition of the atoms should be preserved; but when the carbonyl group (CO) is split off, the aromatic nature and the whole structure of the compound are destroyed. The reaction

$$C_6H_6O = C_5H_5 + CO + H$$

gives a combination C_5H_5 which is without an analogy, and must undergo great changes in order to pass into stable bodies.

The Experiments with Creosote.

The raw material was a coal tar creosote having a specific gravity of 1·038, and known in commerce as *creosotum album*. It was a brownish red liquid completely soluble in a solution of caustic potash of specific gravity 1·33. On cooling to 32° Fahr., it gave no deposit. It consisted chiefly of the ortho-, meta-, and para-cresols (oxytoluenes), which boil between 374° and 392° Fahr.; 3·5 per cent. of the creosote distilled over below 374° Fahr., 28·5 per cent. below 383° Fahr., 48 per cent. below 392° Fahr., and 15·2 per cent. below 406·5° Fahr., while the residue remaining undistilled at the latter temperature amounted to 4·8 per cent.

The gasification of 72 grammes of the creosote in the same manner as the phenol yielded in six hours 44,679 c.c. of gas, which corresponds to a make of about 2 c.c. per second. The experiment was brought to a conclusion owing to stoppage of the gasification tube by deposited carbon. The gas at the start was yellow; but later it became nearly colourless. The specific gravity of the dry gas was ·4636; and therefore the weight of one litre was 0·5999 gramme. The gas, freed from air, had the following composition in volumes per cent.: Ethylene, 1·5; carbonic oxide, 29·2; hydrogen, 50·2; and methane, 19·1. The tar and absorption vessels yielded 14·7 grammes of distillate coming over below 248° Fahr. It was much clouded by water derived from the creosote; and after drying and filtering, it amounted to only 12·3 grammes having a specific gravity of ·8992.

* See "JOURNAL," Vol. LXIX., p. 589.

The benzene in it, as calculated from the yield of nitrobenzene, was equivalent to 10·54 parts per 100 parts by weight of creosote. No determination of the olefines in the tar was attempted. In the gasification tube were found 21 grammes of soot-like carbon. The products obtained corresponded to the following amounts per 100 parts by weight of creosote gasified: Ethylene, 1·13; carbonic oxide, 21·94; hydrogen, 2·70; methane, 8·25; carbon, 28·38; benzene, 10·54; tar and other unexamined products, 21·21; loss, 5·85.

If the decomposition of the creosote happened according to the formula—

$$C_7H_8O = CO + CH_4 + 4H + 5C$$

there should be obtained 25·68 per cent. of carbonic oxide, 4·61 per cent. of hydrogen, 14·67 per cent. of methane, and 55·04 per cent. of carbon. The amounts of these products actually obtained corresponded to the following percentages of the theoretical yields according to the above formula: Carbonic oxide, 85; hydrogen, 59; methane, 56; and carbon, 51. The illuminating power of the gas was very low, as with an 8 cubic feet burner only one-third to one-half of a candle was found.

In view of the great yield of benzene, it was thought interesting to make another test, and omit the washing-vessels, so that a part of the benzene might be retained in the gas, and its effect on the illuminating power observed. Therefore 114 grammes of creosote were gasified in two hours, and yielded 51,365 c.c. of gas having a specific gravity of ·6176. There were obtained 65 grammes of tar, which were found to contain 7·22 grammes of benzene, which amount indicates, when compared with the results of the first test, that some benzene was retained in the gas. The illuminating power of the gas when consumed at the rate of 4·59 cubic feet per hour in a 5 cubic feet burner, under a pressure of 7-10ths, was 3·5 candles. Though this power was very low, it was considerably higher than in the case of the gas from which all the benzene had been washed; and the effect of the benzene was therefore very evident.

(To be continued.)

BRITISH ASSOCIATION OF WATER-WORKS ENGINEERS.

The third paper read at the recent meeting of the Association was by Mr. E. T. Hildred (Southampton). It consisted mainly of a description of the

NEW WORKS FOR THE WATER SUPPLY OF GOSPORT.

Until recently the whole of the water supply for the Gosport Water Company's district was drawn from wells and borings sunk into the sandy beds of the Bagshot series at Bury Cross. Notwithstanding the carrying out of various costly well works (which the author described), the supply has been, during successive summer months, more or less inadequate. The total daily yield has only been 320,000 gallons. The author considered that, while forming an interesting example of a water supply derived from the tertiary beds above the London clay, the Bury Cross works conclusively point to the improbability of obtaining supplies of any magnitude, with reasonable outlay, from this formation.

The need of increasing the supply becoming year by year more urgent, the Company, in 1893, consulted Mr. W. Whitaker, who reported strongly in favour of obtaining water from another geological formation than the one already drawn from. He advocated making a well and headings in the chalk which, at Foxbury Point—the northernmost limit of the Company's district—could be reached at a reasonable depth; the London clay and the Reading beds being there at the surface. Acting upon this recommendation, a trial bore was at once put down; and the chalk found at a depth of 162 feet. The boring, while not yielding any great quantity of water from the upper chalk, was thought sufficiently successful for deciding upon the sinking of an experimental shaft, which, in the event of success, could in part be adopted for the permanent pump well. Mr. Woodman Hill, who was advising the Company at this time, advocated, in the first instance, a brickwork in cement steined shaft 9 feet diameter, carried down to a depth of 82 feet, or 4 feet into the Reading beds, from which a temporary timbered excavation 5 ft. 6 in. square should be continued 58 feet into the chalk, a total depth of 220 feet from the surface, at which level trial headings were to be driven. Little or no difficulty was anticipated by the Contractors in dealing with the loamy sand bed located by the trial bore. The water therefrom, though of inconsiderable quantity, rose to within 22 feet of the surface. The brickwork lining, it was thought, would effectually keep it back, and prevent it following the excavation down. Subsequent experience, and the failure in two separate attempts to get through this particular strata, conclusively proved it to be an obstacle of no mean order to combat. It was evident that to get through these wet beds—more or less quicksand of a treacherous character—other means must be devised; and to the third and final attempt success was wedded by the adoption of the following means: A brickwork shaft of the dimensions originally settled upon was carried down 42 feet in the clay. From this level, cast-iron cylinders sunk for a further distance of 40 feet shut out the top water and quicksand. Below the cylinders, and extending to the full depth of 220 feet from the surface, the excavation is enlarged, giving a clear diameter of 11 feet. So much as passes through the Reading beds is lined with 18-inch brickwork in cement, taking a bearing upon the solid chalk below. The cast-iron cylinders, in lengths of 5 ft. 4½ in., of 1¼ in. metal, each composed of five segments internally flanged, give a clear internal diameter of 9 feet. Difficulty was experienced in getting the cylinders down; the frictional resistance offered by the shifting and unstable bed of sand naturally being excessive. So soon as the cast-iron cylinders were *in situ*, and the water dammed back, and prevented from following down the well behind them, it assumed its normal level of 22 feet from the ground surface, and filtered through the brick steining above. The character of this water made it essential that it should be eliminated, and prevented from mixing with the supply to be derived from the chalk. A lining of ¼-inch riveted steel plates, bolted together with angle-irons in 3-feet lengths, with cement grout run in behind, was therefore fixed inside the brickwork above the cylinders, and proved successful.

The Company adopted a report by Mr. William Matthews, of Southampton, as to the best means of dealing with the new water supply; and the author was appointed Engineer to design and carry out the new water scheme, comprising headings, pumping-station, water tower and tank, main laying, &c. The works have been designed with the view of ultimately closing the old ones. The author calculates that by 1911, the quantity of water required will be 1 million gallons per day, at 30 gallons per head. The total water storage provided includes the incorporation of the Bury Cross tank with the new scheme, and represents approximately one-third of a day's consumption, or 300,000 gallons. This upon first consideration may naturally appear to water engineers an inadequate provision, even in a pumping scheme, but is explained by the configuration of the district, which affords absolutely no natural site, within a reasonable radius of the works, for a service reservoir.

In settling the details of the machinery, two very important factors had to be taken into account: (1) It was desirable that, both from an economical and time point of view, the arrangement should be such that the pump work could, in the first instance, be erected independently of the engine, and set to work by the installation of temporary driving power and intermediate gear, so as to deal with the great quantity of water expected to be found in driving the headings. (2) That the type of engine adopted should not require foundations of a very massive and weighty character to be built immediately over or close to the well-shaft, as the ground thereabouts could not be trusted under such conditions. The engine decided upon, therefore, is a horizontal compound surface-condensing engine of the receiver type, running at 80 revolutions per minute, and driving, through spur and pinion gear, two single-acting deep-well bucket pumps, worked off double rocking-beams. The two single-acting bucket pumps—each 11⅛ inches diameter and 4 ft. 3 in. stroke, working opposite, and at a speed of 20 strokes per minute—are fixed with their pump heads above the normal water-level in the well, so as to be at all times accessible for repairs and overhaul. Steam, at a pressure of 120 lbs. per square inch, is supplied by two water-tube boilers of the Babcock and Wilcox type, each having a heating surface of 735 feet super, and a firegrate area of 16⅜ feet super. The contract performance of the plant was to raise and deliver, through about 200 feet of 15-inch pipes, at least 45,000 gallons per hour against a total head of 284 feet, with a consumption guaranteed not to exceed 2800 lbs. of best Welsh steam coal in twelve hours; the water raised to be measured by actual tank gaugings. At the date of the trial, the specified conditions were not possible, there being no tank to measure the water into; and, as a reasonable alternative, calculations were made and accepted based upon the actual pump displacement, less 2½ per cent. for slip—the pressure in the main meanwhile being kept as near the stipulated head of 284 as possible. The average indicated horse power was 72·52; average pump horse power, 54·50; mechanical efficiency of the engine, 75·15 per cent. The coal consumed during the 12-hour trial was 1528 lbs.; per indicated horse power per hour, 1·74 lbs.; per pump horse power per hour, 2·33 lbs. The water pumped was 46,789 gallons; and the head of water against pumps was 231 feet. The coal consumption of 1528 lbs., with the pumps delivering their full complement of water against an average head of 231 feet, represents proportionately a total coal consumption of 1878 lbs. under contract conditions, or a saving in fuel of 33 per cent. upon the guarantee.

In describing the pumping-station, buildings, &c., the author pointed out that a very effective method of stopping the infiltration of the surface water to the well-shaft was carried out. Surrounding the buildings a 6-inch open-jointed subsoil drain with outlet main is laid immediately adjoining and below the concrete footings of the external walls; the trench, 2 ft. 3 in. wide, being filled up solid to the surface with ballast.

The water-tower is placed close to the pumping-station; so that the length of the pumping-main is reduced to a minimum. The covered tank, to be erected upon the brickwork tower at an altitude of 67 feet above ground surface, is circular, 54 ft. 4 in. in diameter, has a spherical bottom, and a water depth at the centre of 27 feet, with a storage capacity, when full, of 230,000 gallons. It is to be constructed entirely of riveted steel plates. The design is novel, the principle of which, so far as the author's knowledge goes, has been adopted but twice before in this country, notably in the Norton tank of the Vyrnwy scheme, and a small example at King's Lynn. The construction combines

strength with economy, dispenses with all internal tie-rods and supporting girders, and allows of an even distribution of the weight, in a direct manner, upon the supporting walls.

A line of 15 and 12 inch pipes delivers the water into Gosport. The pipe sockets, of special design, are jointed with lead only. In the 12-inch pipes, the lead joints were 1¾ inches deep and ⅛ inch wide; and in the 15-inch pipes, 2 inches deep, and the width also ⅛ inch. The average cost per ton of the 12-inch pipes, 9 feet lengths, was £4 14s. 6d., and of the 15-inch pipes, 12 feet lengths, £4 5s. Including pipes and labour, the cost of main-laying was 13s. 3d. and 15s. 6¾d. respectively per yard run.

The headings (which are camber headed, 6 feet high by 4 feet wide, driven at a level of 9 feet above the bottom of the well) have a combined length of 1086 feet run, and yield, with the well, 1,100,000 gallons per day. The chalk throughout the workings is of a dense and extremely hard character; the walls and roof needing no support. The workings required ventilating when they had reached a distance of 120 feet from the shaft. A 6-inch fan driven from off the portable engine, supplied the necessary air current through a 6-inch square wooden trunk to the bottom of the well, and thence by 4-inch cast-iron pipes, clay jointed, as branch carriers along the headings. The total cost of the headings per foot run averaged £4 8s., or per cubic yard £4 19s.

The following is the total cost of the works (legal, engineering, and contingent expenses omitted): Land, £600; trial boring, £173; well, 9 ft. and 11 ft. diameter, 220 feet deep, including brickwork and cast-iron steining and steel-plate lining, £3043; headings, £4928; pumping and gravitation mains and fittings, £4660; pumping machinery, £3863; engine and boiler-houses, chimney shaft, coal-store, two cottages, drainage, roadway, and boundary wall and fence, £3963; tower, £2884; tank, £2642—total £26,758.

Discussion.

Mr. W. Whitaker (Croydon) said it seemed to him that everything was done that could be done to get water from the beds of sand at the old works; and he did not think they could have obtained any more water from that source. He therefore came to the conclusion that the Company should go to another source of supply; and the place where the new works had been constructed was the only part of their district where they could expect to get to the chalk at comparatively slight expense. The only thing they would have to be careful about would be the drawing in of salt water; but that was easily guarded against.

Mr. W. Watts (Sheffield) was rather astonished that it was considered necessary to introduce some artificial mode of ventilating the heading at a distance of 120 feet. He had just completed a tunnel, and had had no difficulty in working it at a distance of 240 feet without any means of artificial ventilation. Of course, in ventilating headings, a great deal depended upon the rate at which the material was pushed out and in, and also whether there was water in the headings. The movement of the men in and out was a good thing for ventilation, and also the flow of water. It was not stated whether explosives were used. Where explosive material was employed, ventilation was much retarded; and in order to keep the men healthy, it was necessary to resort to artificial ventilation.

Mr. C. H. Priestley (Cardiff) noticed that the depth of the lead joints in the 12 and 15 inch pipes was 1¾ and 2 inches respectively. This depth seemed very small; and he should like to know if it was correct. He also inquired the date at which the contracts for the pipes were entered into at £4 14s. 6d. and £4 5s. 1d., whether those prices included inspection at the foundry, and what was the rate of carriage to Gosport. It seemed to him that the walls of the tower were rather weak for supporting the large tank, with 102 tons of water.

Mr. C. J. Hobbs (London) thought the Company were well advised when they adopted the type of machinery they had put down. Not only was it very economical, but it was simple. There was rather a tendency to over-rate the extra complication of machinery, without an adequate return for fuel consumption. As to gearing, he was not very fond of it; but in this case he thought it was of the best form that could be used. It was an important point as to whether it was advisable in many cases to put the whole machinery direct above the well. He very much favoured the design described where they had two pumps in the well, and the engines apart from it.

Mr. H. Ashton Hill (Birmingham), referring to the well, said he gathered that the author used less brickwork above the cylinder. He wondered why he did this, seeing that he was bothered with water that he wanted to keep separate from that in the well. He was curious to know why he did not put in cylinders at the top, or built the brickwork up with cement, and so have kept the water out. With regard to the overhead tank, he thought the author did the best he possibly could under the circumstances. Where they had not land for a reservoir, the next best thing was to erect an overhead tank. They could, of course, do without both, and pump direct from the engine. Mr. Bancroft had not a reservoir at Hull. It was, however, better to have one if possible; but if they could not have one—say, for three days' supply—it was a good thing to have an overhead tank. He asked the author to give the approximate cost of the overhead tank and tower. Then with regard to engine trials and actual measurement, he thought that engineers very often specified the duty to be calculated in a certain way; but when they came to make the trial, they could not get the head required. It was rather a loose way of specifying the duty of the machinery, that the pumping should be by pump displacement, instead of actual measurement, less 2½ per cent. for slip. This 2½ per cent. for slip might be anything up to 33 per cent., according to the class of bucket. Not long since in a test of a new engine of modern type, he found something like 33 per cent. slip; and in the report of the Royal Commission on the Metropolitan Water Supply, varying percentages were given. The experiments and investigations made by Mr. Middleton as given in that report were very important. He (Mr. Hill) had applied the calculations to his own engines (about 27 in number and of all types), and found they had from 4 per cent. up to 13 per cent. slip. It seemed to him that the cost given by the author for the headings was rather excessive.

Mr. W. G. Peirce (Richmond) referred to the difficulties the author had experienced with timbering in the sinking of the shafts, and said it always seemed to him that timbering in sand was a wrong thing to do. He gave illustrations of the difficulties he had himself experienced—particularly by the breaking of cylinders—in sinking wells in the Thanet sands at Richmond. As to the cost of driving adits, they commenced at Richmond by contract work, at £4 and £3 per foot. This was too costly; and he recommended his Committee to purchase the contractors' plant, and continue the work themselves. They had since carried out nearly 9000 feet of adits at an average cost of 30s. per foot. With regard to ventilation, they were obliged to put down a ventilating-fan when they reached 600 yards; but on tapping the old well 800 yards distant, they got an up and down draught. There was no need for mechanical ventilation if they had two shafts.

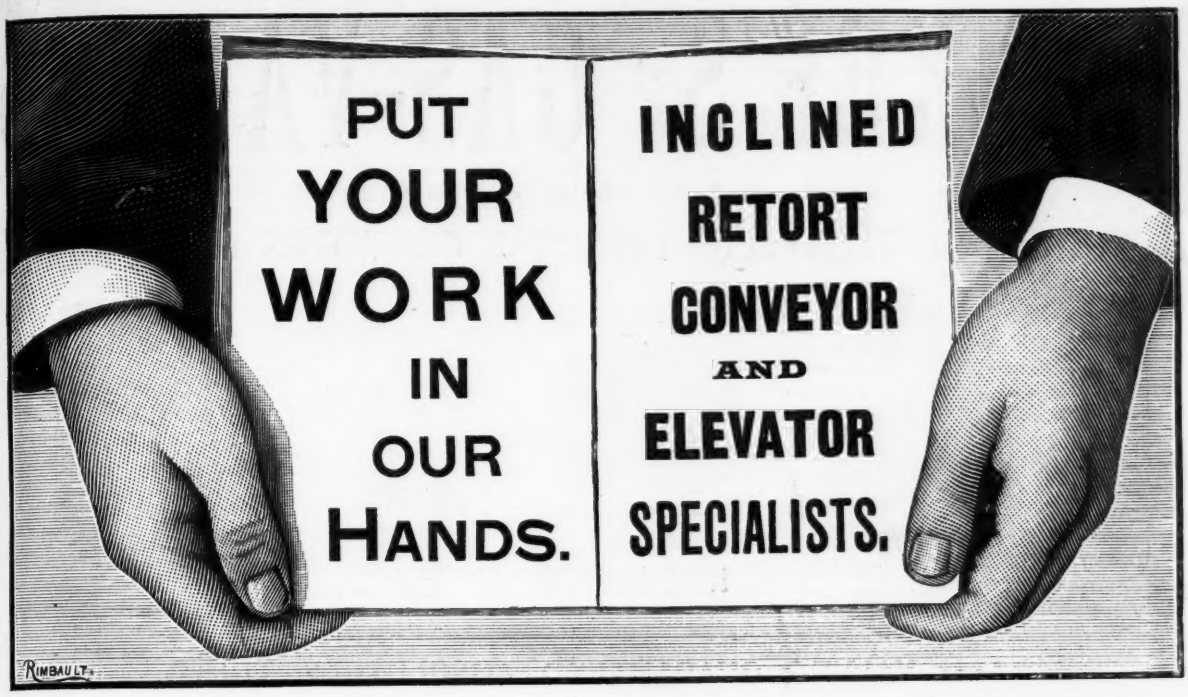
Mr. Woodman Hill remarked that the brickwork of the well was built in with portland cement; and he had never found brickwork in portland cement that would keep water out. Regarding the sand described by the author as quicksand, if the members had had a sample before them they would have said that it was stuff that would not have given way as it did, and that it could have been got through very easily. It was a very deceptive material. As to the cost of the headings, it made one's mouth water to hear that work had been done at one-third of the price mentioned in the paper. The chalk at the Gosport works was very hard; and it had to be chiselled out, as it were. There was a lot of uncertainty in carrying out works of this kind; and he strongly advocated the consulting of a geologist before commencing the engineering work.

Mr. F. J. Bancroft (Hull) said the author had certainly been very unfortunate with the timber shafts he sunk. He (Mr. Bancroft) had recently put down five timber shafts to a depth of 70 feet, and had not had the slightest trouble. These had been taken through clay and sand lying on the top of chalk. The amount of water pumped by the contractor had been 3 million gallons per day; and he had to pump a very considerable quantity before he reached the chalk. He agreed with Mr. Ashton Hill that it would have been preferable to have carried the cylinders from the top to the bottom of the well.

Mr. Percy Griffith said it was interesting to hear experience gained in getting water from the sand between the London clay and the chalk. He had also been interested in that particular strata; and he believed the water there was good in quality, but was very difficult to get, owing principally to the fact that it carried with it such large bodies of sand, which made it almost impossible to deal with. As to the ground water getting into the well through the brick lining near the surface, he said the procedure he had adopted in such cases had been to line the well first of all with 4½-inch brickwork built in cement, and to render that with an inch or so of neat cement. Then on the inside he put a second ring of 4½-inch brickwork. He had never found any difficulty with a well constructed in that way.

Mr. Hildred, in reply, said as to the ventilation of the workings, they were troubled with foul air at a short distance from the well. It became apparent almost immediately a fissure yielding any considerable amount of water was tapped; and as they tapped fresh fissures, they found the ventilation had to be increased. The chalk being extremely hard, the progress of the headings was comparatively slow; and therefore there was no great circulation of the air in the adits occasioned by the passing of the men to and fro. No explosives were used. As to the price of the pipes, it did not include testing at the foundry. The pipes as delivered were guaranteed to have been tested to a pressure of 200 feet head of water; the maximum pressure on the main being practically 100 feet head only. The design of joints adopted was the pattern which had been in use in Southampton for a good many years, and there the pressure averaged about 65 lbs. per square inch—the maximum being 100 lbs. At Gosport they had not had a single joint give on the 3¼ miles of main. The cost of the water-tower was £2884; and the tank £2642. In his opinion, the walls of the tower were quite sufficient for the weight they had to bear; the maximum pressure on the brickwork being only 8 tons per square foot. He might say that the well was actually completed before he was appointed Engineer to the Company. It was very cramped with machinery; and there was no room to continue lining to the surface with cylinders. But he had been successful in stopping, from the outside, the infiltration of the water. As to the price of heading work, there were many details to be taken into consideration; and these were not always given, so that no reliable comparison could be made.

A vote of thanks was passed to the author for his paper.



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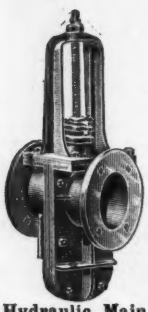

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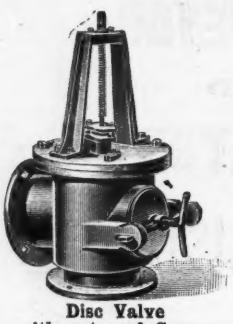

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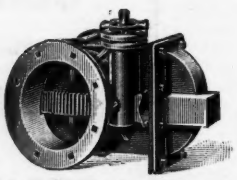

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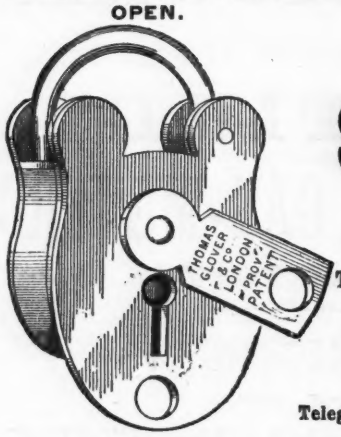

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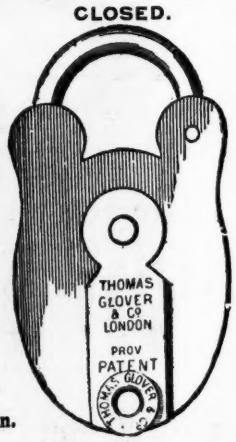

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CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

The Accident Fund of the South Metropolitan Gas Company.

SIR,—I would not occupy your space with a reply to your anonymous correspondent "G.," but that his letter seems to support the idea that high premiums will be necessary to meet the claims under the Workmen's Compensation Act. He quotes the term "contributory negligence;" but those words are not to be found in our rules, or my report on the working of our mutual fund. We use the very different expression "gross negligence," which was adopted last year before the Act was passed, and which I understand to mean the *sole* negligence of the injured man; whereas contributory negligence surely means that it, jointly with other causes, produces an accident. Gross negligence is not appreciably different from the "serious and wilful misconduct" of the Act.

"G." asks whether "in every one, or even in any considerable number, of the 22 cases classified . . . as caused by the injured man's gross negligence," I could have successfully established the Company's immunity from liability under the Act; and he then talks about the cost that would have been incurred in fighting, and says I certainly should "have to fight for that exemption." If "G." had carefully read the whole of my report published in last week's "JOURNAL" (p. 1328), he would have seen that in 16 out of the 22 cases the incapacity for work did not exceed a fortnight. There can therefore be no doubt about their exemption. As to the remaining six, either the Accident Fund Committee or a jury of workmen classed them as caused by gross negligence. To give two instances of which I happen to know the particulars. A man, instead of using the proper lever, attempted to change the strap of a power-driven chaff-cutter with his hand, and got his arm broken. In another case, a man, instead of returning the proper way—which he had just traversed—passed at night along a tramway blocked with a coal waggon, and in trying to get past this obstruction fell and broke the small bone of his ankle. The gross negligence in both these cases comes under "G.'s" description of wilful; and I doubt not the other four were equally clear, or the juries would not have gone against their fellow-workmen.

Then as to fatal accidents, I said for the last twelve or fourteen years they averaged about one a year. "G.," however, takes the shorter period of six years, and puts it at 0·83 per half year, which is too high. The fact that he takes the highest figure justifies my opinion of his letter, as stated in my opening paragraph. Taking the average of one fatal accident a year, there would certainly be some that could have obtained nothing under the Act. I could give particulars of some such cases. We paid, however, £330 in pensions to widows in the year 1897. I feel sure that had the Act been in operation during the last twelve or fourteen years, the compensation it would have given would not have exceeded £200 a year. It would have amounted, on the average, to something under £250 for each man killed; but some could not have claimed, and some might have left no dependents.

In reply to "G.'s" last question, there is no doubt that some cases that previously would have come on the Sick Fund have been charged to the Accident Fund; there is also little doubt that some men have made claims upon the Accident Fund because they felt that they, being subscribers, had a right to do so, who, if the fund had not been in existence, would not have gone on the Sick Fund. This, however, is a small matter. The broad fact remains that, even with the great increase, whether apparent or real, in the number of accidents, the cost is not serious. Our experience so far proves that all claims under the Act would have been met, and with something to spare, by 5s. per cent. on the wages, and that 10s. per cent. is more than enough to give liberal compensation for all accidents. Under these circumstances, therefore, my advice is, as Mr. Chamberlain advises in to-day's "Times," to take the risk rather than pay an extravagant premium, of which I believe 40 per cent. goes in management expenses, &c. This will all be saved if a Company is its own insurer; but a Mutual Fund is the best of all systems.

June 17, 1898. GEORGE LIVESEY.

The Temperature of Gas Measurement.—A Correction.

SIR,—There is a small technical error in my letter appearing in the last number of the "JOURNAL," which, to prevent misconception, I wish to rectify. The phrase in the last paragraph, "they seem to have compared the atmospheric temperature of the gas sent out with the temperature of the gas at the consumers' meters," should read, "they seem to have compared the atmospheric temperature at the works with the temparature of the *gas* at the consumers' meters."

June 17, 1898. H. LEICESTER GREVILLE.

Suggested Repeal of the Conciliation Act.

SIR,—In public speeches and sentimental petitions, no less than in press paragraphs and correspondence, the President of the Board of Trade is constantly urged to exercise "the powers conferred on him by the Conciliation Act of 1896." May I point out the fact, seemingly lost sight of, that the Act in question confers no powers whatever. As a matter of fact, by repealing the then existing Acts, which, though "dead letters," did provide in some measure for compulsory action, it distinctly took away all power of compulsion by an official outside body. The Act is purely permissive. Briefly summarized, it formulates in a concise statement what the Board of Trade *may* do in an endeavour to advance conciliation in labour disputes, if it feels called upon to interfere, or to accept the invitation of one side or the other to interfere. Any Board of Conciliation or Arbitration "may apply" to the Board of Trade for registration. The Board of Trade are to keep a register of Conciliation Boards, and "from time to time present to Parliament a report." All the privileges thus categorically accorded to this Government Department were possessed and exercised by it before the Act was passed. The only difference is that the Labour Department's previous informal record has merged into an official register, now involving a special report instead of one incorporated with Mr. Burnett's excellent annual summary of voluntary action, and that a sinecure has been created for the keeper of the register.

That the Act is a lamentable failure it is not possible to doubt. A mistaken impression is current throughout the country as to its intent and operation. In all important cases in which Mr. Ritchie has professedly availed himself of its permission to suggest a policy, the evils he sought to ameliorate are only intensified. The simple way to relieve him and future Presidents of the Board of Trade from much embarrassment, and restore faith in existing voluntary methods of solving industrial difficulties, is to repeal the Conciliation Act of 1896. Why does not Mr. Ritchie himself acknowledge, after two years' fair trial, the failure of his "experimental legislation," and at once bring in a Repeal Bill? The Bill would pass.

Liberty and Property Defence League, June 17, 1898. W. J. SHAXBY.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bills brought from the Commons, read the first time, and referred to the Examiners: Clacton-on-Sea Gas and Water Bill, Coventry Corporation Gas Bill, Cromer Gas Bill, Drogheda Gas Bill, Gainsborough Gas Bill, Gaslight and Coke Company Bill, Matlock Urban District Council Bill.

Bills read a second time and committed: Carmarthen Improvement Bill, Cranbrook District Water Bill, Gloucester Gas Bill, Ilford Improvement Bill, Plymouth and Stonehouse Gas Bill, Southampton Gas Bill, Southwark and Vauxhall Water Bill, Wigan Corporation Bill, Wishaw Water Bill.

Bills reported, with amendments: Gloucester Gas Bill, Thanet Gas Bill (on re-commitment).

Bills read the third time and passed: Brompton, &c., Water Bill, Bury Corporation Bill, Carlisle Corporation Water Bill, Enfield Gas Bill, Gas Orders Confirmation Bill (No. 1).

The opposition to the Newcastle and Gateshead Water Bill has been withdrawn.

The Southampton County Council have petitioned against the Southampton Gas Bill, and the London County Council against the Southwark and Vauxhall Water Bill.

The Wishaw Water Bill has been referred to a Select Committee, consisting of Lord Brougham and Vaux (Chairman), the Marquis of Zetland, Viscount Hardinge, Lord Bagot, and Lord Crawshaw; to meet on Wednesday, June 22.

HOUSE OF COMMONS.

Tuesday, June 14.

MUNICIPALITIES AND ELECTRIC LIGHTING.

On the order for the second reading of the Electric Lighting Provisional Orders (No. 12) Bill, which is to enable the Local Authorities of Bermondsey and Marylebone to lay down mains for the supply of electric energy,

Mr. CRIPPS moved the rejection of the Bill. He remarked that the measure before the House raised some of the most important questions which could possibly be brought forward in connection with the industrial policy of the country, and involved a principle which, if sanctioned by the House, applied not only to electric lighting companies, but to all industrial undertakings, whether for the construction of tramways or the supply of gas and water. The question was whether a private company, authorized by Parliament to carry on an industrial undertaking, who had admittedly carried out all their obligations to the public, should, by means of rate-aided competition, be liable to what was, in substance, expropriation without compensation. This was an insidious and dangerous infringement of the recognized principle of security, that every man should be compensated before his property—particularly property guaranteed under an Act of Parliament—could be attacked or depreciated. There was no precedent for the proposition before the House. Where a private company did their duty under statutory powers, and where no allegation of mismanagement had been made, it was only right and fair that the concern should be bought out before anything in the nature of rate-aided competition was allowed. The principle applied not only to electricity, but to gas and water undertakings. It has been justified, and properly so, from two points of view—that it was the only fair way of treating those who had invested under the guarantee and faith of Parliament; and that, unless a local authority sought to purchase, rate-aided competition was wasteful and wanton extravagance. No private enterprise could, in the long run, hold its own with such competition; and where once Parliament had sanctioned private enterprise, it did not allow it to be unfairly crushed. There was no case here of a company not doing their duty and not fulfilling their obligations. They had the assurance of the Local Authority that the Company were amply and properly fulfilling all their duties within the district. They therefore came back to the pure question of principle—whether it was fair, where a Company had invested their capital on the security of Parliament that the concession was for 42 years, that the ultimate purchasing authority should be allowed to come in and, by means of rate-aided competition, to depreciate the Company's property, or to crush out private enterprise altogether. He moved, as an amendment, that the Bill be read a second time that day six months.

Mr. KIMBER seconded the amendment. Though in the Electric Lighting Act of 1888 it was provided that the fact of a private company having received a Provisional Order should not prevent the Board from granting another Order to a local authority, it was implied that the Department should exercise the power delegated to it upon principles of equity. The Board had the duty, with the power, to see that the recipients of the Order performed the duties required; but it misconceived its duty if it deliberately exercised its arbitrary confiscatory power, saying to a local authority: "Take possession of the undertaking of this successful company; it will enable you to reduce your rates." The

Board of Trade was a *quasi*-judicial body, and should exercise its powers on principles of justice.

Mr. STUART said the speech of the honourable and learned member who moved the amendment was an argument against the Act of 1888; and it was now quite out of date. This was no new raid of an unusual kind. In the Act of 1888 it was distinctly provided that the grant of authority to any undertakers to supply electricity within any area "shall not in any way hinder or restrict the granting of a Provisional Order to the local authority." There was no more to be said about the matter, except that these words were introduced into the Act as the result of prolonged negotiation, and after a due consideration of all the circumstances of the case.

Mr. LAFONE supported the order for the second reading of the Bill.

Sir A. FORWOOD observed that when the Act was passed with the clause reserving power to the Board of Trade to concur in the granting of Licences, it was regarded by the municipalities as a protection to them from the monopolies which had been created by gas companies in previous years. Feeling that they had this protection, they did not oppose the obtaining of Provisional Orders by private parties. Had it been supposed that by not opposing they were going to hang round the necks of the municipalities a monopoly such as that which had been enjoyed by gas companies for years, the Corporation of which he was a member [Liverpool] would have strenuously opposed the passing of any Provisional Order which would have had that effect. The various private electric lighting companies had accepted Orders under the conditions of the Act which had been quoted. The shareholders knew perfectly well the risks and conditions under which they entered into the businesses, and invested their money; and it would be a mistake at this stage to take away from the Board of Trade or the municipalities the powers reserved to them under the Act. Electric lighting would soon become, like gas and water, a public necessity; and as such it ought to be in the hands of the municipality.

Mr. BARTLEY said he was doubtful of the wisdom of local authorities embarking in these undertakings; but there was no doubt that the spirit of the age in London was for them to do so. There was no doubt also that words were expressly inserted in the Act of 1888 to prevent companies from securing a monopoly of electric lighting in their various districts.

Mr. KNOX thought the House should have some guidance from the Board of Trade in the matter. There were two cases dealt with in the Provisional Orders—Bermondsey, in which the Company had not done their duty, and Marylebone, in which the Company had provided a good service. The object of the Act of 1888 was to give security to any company who furnished a good service, and to protect the public against inefficiency and overcharge. But the Board had given to the Local Authority of Marylebone competitive powers with the existing Company in an area which was being well served. This appeared to him to be going beyond the Act of 1888. If private capital were deterred, by such action of the Board, from entering into these undertakings, it would not in the end be for the good of the community.

Mr. RITCHIE said he desired to tell the House the position of the Board of Trade in regard to this matter. Applications for Provisional Orders were not received by the Board from the Local Authorities of Bermondsey and Marylebone alone. In one case the Local Authority and a private Company, and in the other case the Local Authority and two private Companies, applied for Orders for a second supply of electric lighting in their respective districts. The Board had to consider, first, whether or not any additional Order should be granted; and if so, whether it was to be granted to a private Company or to the Local Authority. He had no hesitation in deciding that it would not meet with the approval of Parliament if the Board were to reject the application from the Vestry and give the additional Order to another company. The honourable and learned member for Stroud (Mr. Cripps) had contended that, so long as an existing company were properly discharging their duty, no second Order should be granted in the locality. The meaning of this was that a monopoly was to be given in each area to the company who first obtained the Order. This was not only contrary to the public interest, but absolutely contrary to the direction of Parliament. The Act of 1888 clearly showed the intention of the Legislature to be that a second Order might be granted in any locality, either to the local authority or to another company. Subsequently to the passing of that Act, an inquiry was held by Major Marindin as to the conditions under which Electric Lighting Orders might be granted in the Metropolis; and he laid it down distinctly that two companies might be allowed to have an Order in each area. Therefore it could hardly be said that a company applying for an Order after the Act of 1888, and after the inquiry of 1889, did not do so with their eyes open to the possibility of competition. Honourable members had shown that the competition of a local authority might be keener than that of another company; but, the Act of 1888 having expressly provided that a local authority might apply for, and be granted, an Order, it was impossible for the Board of Trade to adopt any other course than that which they had taken. The Board had not gone into the merits of the case; that was left to the Committee of the House. If the Board had refused either of these Orders, Parliament would have been precluded altogether from considering the applications. His view of section 1 of the Act of 1888 was that it imposed on the Board the duty of receiving applications, and, unless there were some strong reasons other than those which had been advanced, of granting the Order so that it might come before Parliament. If the House rejected the Bill on its second reading, it would not be in accordance with tradition or with public policy.

Mr. BRYCE said the right honourable gentleman had shown that the Board of Trade had no option but to send these proposals to the House. Further, the House was bound to send them to a Committee, for otherwise the Act of 1888 would in effect be repealed. It seemed to be taken for granted that the present lighting arrangements in Marylebone were quite satisfactory. As a matter of fact, he, as a resident, knew that this was far from the case.

Mr. BRODRICK wished to corroborate what had just been said as to the electric light supplied by the Marylebone Company. It had been assumed throughout the discussion that the supply was satisfactory. He could assure the House that those who had the light in their rooms had made many complaints. When it was proposed to grant a monopoly, this should be considered by the House.

The House divided—

For the amendment	114
Against	198
Majority against	—84

The second reading of the Bill was then formally agreed to.

Mr. CRIPPS next moved that the Bill be referred to a Hybrid Committee.

Sir W. HARCOURT objected to this course; and the motion was there upon withdrawn.

Friday, June 17.

THE GASLIGHT AND COKE COMPANY.

Sir ALBERT ROLLIT asked the President of the Board of Trade whether he was prepared to move or support a motion for a Select Committee to inquire into and report upon the exercise of their statutory and other powers as to scales and rates of price to consumers, and as to dividend and otherwise, by The Gaslight and Coke Company, and as to the expediency of the principles upon which such powers were based, and especially as to the injustice of the differential treatment of North and South London by the Company.

Mr. RITCHIE replied that, as he stated in the course of the debate on the consideration of the Company's Bill on the 9th inst. (*ante*, p. 1389), it would be the duty of the Government to consider any proposal for inquiry that might be made in the House; but until the terms of such a proposal were placed on the Table, he was unable to say whether or not he would give assent to them.

The following further progress has been made with Bills:—

Bills read the first time and referred to the Examiners: Bury Corporation Bill, Carlisle Corporation Water Bill, Felixstowe and Walton Water Bill, Filey Water and Gas Bill, Gas Orders Confirmation Bill (No. 1), Newhaven and Seaford Water Bill, Newtown Water Bill.

Bills read a second time and committed: Bacup Corporation Water Bill, Folkestone Water Bill, Halifax Corporation Bill, Hamilton Water Bill, Kettering Water Bill, Tynemouth Corporation Water Bill.

Bills reported, with amendments: Leyton Urban District Council Bill, Local Government Provisional Orders (Gas) Bill, Market Harborough Gas Bill.

Bills read the third time and passed: Clacton-on-Sea Gas and Water Bill, Coventry Corporation Gas Bill, Cromer Gas Bill, Drogheda Gas Bill, Gainsborough Gas Bill, The Gaslight and Coke Company Bill, Local Government Provisional Orders (Gas) Bill, Matlock Urban District Council Bill.

The Bacup Corporation Water Bill, the Folkestone Water Bill, the Halifax Corporation Bill, the Stirling Gas Bill, and the Tynemouth Corporation Water Bill have been referred to a Select Committee, consisting of Colonel Gunter (Chairman), Mr. R. J. Price, Mr. J. Howard, and Mr. W. O'Malley; to meet on Tuesday, June 21.

The following Bills have been withdrawn: Rating of Machinery Bill, Steam Engines and Boilers (Persons in Charge) Bill, Public Health Acts Amendment Bill.

Mr. B. L. Cohen (Islington) has given notice that this evening he will ask for the appointment of a Select Committee "to inquire into the powers of charge of the Metropolitan Gas Companies, and into the method in which those powers have been exercised; and to report whether any modification of the powers conferred by Parliament is necessary, having regard to the differences of prices charged by the various Companies."

¶ **The Derby and District Residual Products Committee.**—Reference was made in the "JOURNAL" for the 22nd of March to a movement set on foot by a number of gas managers in the Midlands for the collective sale of their products with the view of obtaining better prices than those offered by distillers. The Committee, of which Mr. J. Andrews, of Langley Mill, is the Secretary, comprises representatives of sixteen works in the county of Derby and the immediate district; and an advertisement which appeared in the "JOURNAL" last week, inviting tenders for tar and liquor, indicates that they mean business.

London Water Supply.—The report of Sir William Crookes and Professor Dewar on the composition and quality of daily samples of the water supplied to London for the month ending the 31st ult, states that of the 175 samples examined by them all were found to be clear, bright, and well filtered. For the first time this year they had to record an excess of rain at Oxford. The actual fall during the month of May was 2·33 inches; and the average fall during the last thirty years was 1·83 inches; showing an excess for the month of 0·5 inch, and reducing the deficiency for the year to 2·57 inches. The increase of rainfall had made itself apparent in the results of the examinations, both chemical and bacteriological, but only to a slight extent; the water remaining in a very satisfactory condition.

Sales of Stocks and Shares.—At the Mart, Tokenhouse Yard, Messrs. Fox and Bousfield recently sold some £50 "C" shares in the Portsea Island Gas Company at £134 each. Two lots of ordinary consolidated stock of the Staffordshire Potteries Water-Works Company have lately been sold by public auction. The first lot, representing £915, realized £1756 16s.—being a premium of £192 per cent.; and the other lot, worth £200 at par, produced £387 10s. Last Thursday, Messrs. Garrod, Turner, and Sons held a sale at Ipswich, when they disposed of £150 of "A" stock in the Ipswich Gas Company. Nine lots of £10 each were sold for £31 10s. apiece; while six similar lots realized £31 15s. each; eight £10 lots of "B" stock in the same Company fetched £25 per lot; eleven similar lots realizing £25 5s. per lot. On the same day, 100 £5 fully-paid ordinary shares in the Langley Mill and Heanor Gas Company, Limited, were publicly sold at prices varying between £10 16s. and £11. In the Commercial Hotel at Brechin, on Thursday, 19 shares of the Brechin Gas Company were offered for sale by auction. They were sold separately—four at £24 5s. each, and the remainder at £24 2s. 6d. each. The shares were originally £5 apiece. They carry with them the dividend for the past year, which is expected to be £1 7s. per share.

MISCELLANEOUS NEWS.

CHEAP GAS FOR WIDNES.

At the Meeting of the Widnes Town Council last Tuesday, Alderman H. S. Timmis, in moving the adoption of the Gas and Water Committee's minutes, said that for the past year there had been a net profit on the gas account (after providing £1457 for the cost of the public lighting) of £2072; and he was in a position to put before the Council a proposition which would be sufficient to make the gas committees of other towns green with envy, and cause the gas managers all over the country to despair. From the 1st of July the price of gas to all consumers within the limits of supply would be reduced by 2d. per 1000 cubic feet, which was equal to a charge of 1s. 4d. and 1s. 6d. per 1000 cubic feet—a price which could not be approached in point of cheapness by any other town in the country. The quantity of gas supplied by prepayment meters would be increased from 33 feet to 36 feet for a penny. Taking the price of gas charged in other towns, the reduction would mean an annual saving of £15,000 to the consumers in the borough, which was equal to a rate of 2s. 4d. in the pound. Though it was intended to sell at this extraordinarily low figure, it was confidently hoped that the minimum was not even yet reached. The additional business which would be sure to follow this reduction would secure increased profits in the future; and if these were made, the Committee would, as in this case, recommend that the ratepayers should receive the benefit. In conclusion, Alderman Timmis requested the Press to take note of these facts, so that manufacturers throughout the land might become aware of them, and be induced to establish new industries in the town. Mr. Shores said he had made a little calculation which he wished to mention. To the 2800 ordinary consumers the reduction of 2d. per 1000 cubic feet was equivalent to a present of 3s. each per annum. In other words, the average cost of gas to the small consumers was 23s. per annum, and the effect of this reduction would be to give them 3s. back. This was a most valuable consideration for the ordinary consumers; and, of course, the saving was very much increased to the large ones. It may be mentioned that the Committee's minutes contained a recommendation that the salary of the Gas and Water Engineer (Mr. Isaac Carr, Assoc.M.Inst.C.E.) should be increased by £100 per annum; but as this involved the suspension of one of the Standing Orders, it was ruled that they could not be submitted as they stood. Referring to this matter, Mr. Smith expressed the belief that when the figures presented to the Council were put before the gas consumers they would be proud of them, and would think it was a short-sighted policy on the part of the Council not to take into consideration the salary of the Engineer. Alderman Sadler suggested that the best thing would be to bring the matter forward in the shape of a bonus at the next meeting. He almost thought it would pass the Council in that form, and thus realize what Alderman Timmis desired. The minutes were then confirmed as amended.

NEW OFFICES FOR THE EXETER GAS COMPANY.

There is no better indication of the growth of a business than the necessity for additional office accommodation; and therefore the need which has for several years past been felt by the Exeter Gas Company for more commodious premises must be taken as a proof that the prosperity of the undertaking is unaffected by the introduction of a rival illuminant. The situation of the offices of the Company has been changed several times in consequence of the development of the business. The last move has been from the High Street to Southernhay, where new buildings—a great deal larger, and far more attractive and imposing, than any of those previously occupied—have been erected for the Company; and they were formally opened last Tuesday.

A vestibule with oak fittings and ceiling of the same material opens into a spacious hall some 24 feet in length, and contains an elaborate tiled chimney-piece. On the left, approached from the hall, is the general office, with a handsome counter; and opening from it is the strong-room. Straight through from the main entrance is a show-room, 40 feet long by 25 feet in width, from which a lift is provided for the conveyance of goods to a smaller room of the same character on the upper floor. On the ground level are the outdoor inspector's office, lavatories, and stores. There is a mezzanine floor containing stores for stationery, &c.; and a broad well-lighted staircase and large landing lead to the waiting-room. On this floor are the Board-room and the Secretary's office, separated by sliding-doors, which, when opened, give an area of 54 feet by 20 feet. The show-room on this floor is about 24 feet square; and there are also three rooms for laboratory use in connection with the testing of residual products. The building throughout is provided with artistic wrought-iron gas-fittings, with incandescent lights; and the general furniture and appointments are handsome and substantial. The floors of the hall and general office are tiled, the remainder of the ground floor being laid with wood-block flooring; and dadoes are fitted round all the rooms. The ceilings throughout are ribbed, and in the Board-room and Secretary's office a handsome raised ceiling has been formed. The drainage has been rearranged and modernized. Behind the main building are two cottages for the overseers, large workshops, and stores, approached by a wide cart entrance. They are of a substantial character, and, with the rest of the building, will not only give the Company better facilities for carrying on their present business, but for dealing with future developments of it.

The opening ceremony, which took place in the Board-room, was attended by a large and distinguished assembly. The Chairman of the Company (Mr. H. D. Thomas) was unable, owing to the state of his health, to be present; and therefore the Deputy-Chairman (Mr. R. T. Campion) presided. Upon the platform was the Sheriff of Exeter (Mr. J. Delpratt Harris), who was requested by Mr. Campion to declare the new offices open. In complying with the request, he gave a few particulars as to the progress of the Company. He said that in the matter of illumination by gas the Metropolis of the West was to the fore in 1816, in which year people came from far and wide to see the new light, in much the same way that, in more recent years, they came to see the electric light. Since then the Exeter Gas Company had obtained Acts of Parliament enlarging their powers in 1836, 1865, and 1878. Their first gasholder had a capacity of only 8000 cubic feet, and was enclosed in a brick building for safety. The coal annually carbonized at first was about 250 tons. Having exhausted their powers by 1836, the Company applied for an extension. The coal carbonized was at that time 800 tons per annum; but even in those rather remote times the undertaking was thriving, and going from good to better. In 1865, when the Company obtained further parliamentary powers, the coal annually carbonized had risen to 8600 tons; and the gas made amounted to 84,085,000 cubic feet. The last occasion when the Company obtained additional powers was in 1878, when they were authorized to raise £125,000, of which £45,000 had been issued—leaving £80,000 available. In the year of this Act, the coal carbonized was 17,432 tons; and this had risen to 23,987 tons last year. The gas made in 1878 was 160,919,000 cubic feet; last year it had increased to 240,389,000 cubic feet. All this went to show that the gas industry was most thoroughly established, and that gas was used not only by a greater number of people, but in an increasing degree, in consequence of its advantages over the crude material in the way of cooking and heating. The growth in consumption necessitated an increase in the Company's accommodation; and this brought him to the object for which they were assembled—to inaugurate the palatial offices. In the absence of the Mayor, who was taking a few days' well-earned rest, he declared the building open.

Mr. A. S. Perkins proposed a vote of thanks to the Sheriff. In doing so, he remarked that the advance of the Gas Company certainly tended to make Exeter more prosperous, for it was one of the largest commercial undertakings, and materially reduced the rates and taxes of other people—paying £1000 a year in this way, and £800 a year for canal dues. Mr. E. H. Shorto, in seconding the proposition, said the Company had a fine ship and a splendid crew; but there was a good captain at the helm. The city of Exeter might well be proud to possess a Gas Engineer of the eminence and distinction of him whom the Company had the honour to count as their Manager and Chief Engineer. The vote having been heartily accorded, the Sheriff, in responding, proposed a cordial vote of thanks to the Chairman (Mr. Campion), coupling with it the name of Mr. Padfield. The Chairman acknowledged the compliment. Referring to Mr. Padfield, he said that he had watched with the keenest interest the great care which Mr. Padfield had taken in the management of the Company; and the building in which they were assembled was entirely due to him. They had a captain of whom they might well be proud. Mr. Padfield, in compliance with calls, also responded. He said the question of artificial lighting turned on two points. Any system, to succeed, must have a commercial value; and it must give a light able to compete with electricity. Both gas and electricity had a distinctive value; and he believed that, in the long run, they would find gas still more valuable and useful than it was at present. He had the greatest faith in the future of gas; and he saw no limit to the progress of the Company. As production was cheapened, gas would be more extensively used; and he had so many improvements in mind that if he could make them all to-morrow he believed gas would be produced at 1s. per 1000 cubic feet. The proceedings then terminated.

In order to enhance the interest of the opening ceremony, and to give their guests an opportunity of becoming better acquainted with the developments of invention in regard to the manufacture and supply of gas, the Directors arranged a collection of drawings, photographs, and models of the latest appliances used. They were furnished by West's Gas Improvement Company, Limited, Messrs. Bryan Donkin and Co., Limited, Messrs. R. and J. Dempster, Limited, Messrs. Edward Cockey and Sons, Limited, Messrs. George Waller and Co., and Messrs. Mobberley and Perry. Meters of the ordinary and prepayment kinds were shown by Messrs. W. and B. Cowan, Limited, the Gas-Meter Company, the Prepayment Gas-Meter Company, Messrs. Thomas Glover and Co., and Messrs. Willey and Co. Messrs. Fletcher, Russell, and Co., Limited, sent a collection of technical gas appliances for use in various trades; and the Badische Anilin und Soda Fabrik and Messrs. Jonas Drake and Son exhibited samples of dyes and products obtained from coal tar. Incandescent gas-lights and special shades for ordinary lights were also on view.

RAMSGATE CORPORATION GAS AND WATER SUPPLY.

The Past Year's Working.

At a Meeting of the Gas and Water Committee of the Ramsgate Corporation on the 9th inst., the Chairman (Mr. C. J. Gwyn) read his annual report. He began by pointing out that, as had been the case generally, the past financial year had not been so prosperous as the preceding one—a state of things which, he said, was due to want of expansion resulting from the prevalence of mild weather. Raw material had advanced in price; while residuals, more especially tar, were in a depressed condition. The make of gas in 1896-7 was 182,594,000 cubic feet; whereas in 1897-8 it was 186,855,000 cubic feet—being an increase of 4,261,000 cubic feet, or only about 2·33 per cent., as compared with 11·95 per cent. before. The gross profit was £7010, as compared with £7477, in 1896-7. He explained that the small difference was more than accounted for by the higher price of coal, the increased cost of public lighting, and a larger amount paid for rates and taxes—amounting altogether to £622. The only item to which he thought it necessary to direct attention particularly, and which required a little explanation, was a sum of £290, the increased cost of public lighting, due to the fact that, since the introduction of the incandescent system generally, additional labour and upkeep had been required. This, added to the cost of the mantles, amounted for the past year to £290 more than for ordinary lighting; while the charge made on the district fund had not been increased. The amount paid for new gas-stoves was £489; bringing up to £4214 the total expenditure on these appliances. The amount written off the stoves account was £430. During the past year, £613 was expended in supplying houses with gas-fittings on the prepayment system; and a sum of £620 was written off the account. There were now 1403 consumers under this system; and the total outlay in fitting up houses had been £3804. He remarked that many gas companies and corporations employed their capital for these

purposes, and did not write off the amounts in the way they did at Ramsgate. He said it would be quite legitimate for the Committee to take part of the amount written off for stoves and fittings, and call it profit; but by pursuing the course they followed, the capital account was kept down, and the general value of the undertaking from year to year proportionately increased. The amount of net profit for the year was £1779, against £2484 in 1896-7. The difference of £705 was made up by the items in the revenue account to which he had referred, added to increased charges in reduction of, and dividend upon stock. The amount paid out of the profits by the Gas Department in aid of the district rate up to the end of the year 1896-7 was £28,380; the addition of last year's profit making a total of £30,159. There was a reserve fund of £5028; and the redemption of capital was going on at a rate which would in a limited number of years clear off the whole indebtedness of the concern. With regard to the Water Department, the gross profit last year was £5556, as compared with £5661. There had been an increase of £249; but, on the other hand, there was extra expenditure to the extent of £358, due to additional pumping, &c. The total capital expenditure on the works had been £126,749, out of which £13,084 had been paid off; leaving an indebtedness of £115,665 on capital account. The amount paid out of the profits by the Water Department in aid of the district rate up to the end of 1896-7 was £4502—the addition of last years's profit making a total of £4996; and the reserve fund amounted to £4153. Commenting upon the report, Mr. Gwyn said there must always be some forces at work contributing to make the gross profits differ somewhat; and in view of the reduction effected in the price of gas, he did not think the public could expect it both ways. If they had cheap gas, there would be less to hand over in relief of the rates. By selling it at 2s. 8d., they had made £1779 profit. They could have sold at 2s. 6d., and then have made £361. If from the 2s. 6d. they deducted the cost of the coal dues—viz., 3d.—the price would be reduced to 2s. 3d., which equalled that of the South Metropolitan Gas Company, which was the cheapest in the South of England. He added that he should like to give some information as to how the profit stood now as compared with the year 1894-5. It was then £6532, and the price of gas was 3s. 2d. per 1000 cubic feet. The net profit for the past year was £1779, and the price of gas 2s. 8d. Adding for the difference in the price to consumers £4254, and for the difference in the market price of residuals £1663, they found that the profit, as compared with 1895, all things being equal, stood at £7696. This showed that the past year could not be called bad—it only looked a little less favourable as contrasted with the year immediately preceding it. That was a record year, the net return being very exceptional; so much so, he thought, as to surprise the Engineer (Mr. W. A. Valon) himself. An official of the Board of Trade had expressed the opinion that the Ramsgate returns were perfectly phenomenal. He (Mr. Gwyn) thought this was a very good testimony to the conduct of the works, and to the results they obtained from them. The report was adopted.

MALTA AND MEDITERRANEAN GAS COMPANY, LIMITED.

The Ordinary General Meeting of this Company was held last Tuesday, at the London Offices, 60, Gracechurch Street, E.C.—Mr. J. Birch Paddon presiding.

The Secretary (Mr. A. W. Cooper) read the notice convening the meeting; and the report and accounts for the year ending March 31 were then submitted.

The Chairman, in proposing their adoption, said the history of affairs in Malta had been practically the history of the Company's affairs; and, apart from the considerable loss of business resulting from the electric light enterprise of the Government, their working in Malta had been satisfactory. The same might be said of their operations generally. Twelve months ago, the Directors expected they would be able to maintain the present dividend with the assistance of the reserve fund. It was now an accomplished fact that they had made profit sufficient to pay the whole of the customary dividends and to carry something to the reserve fund, instead of taking anything from it. It was estimated that the loss of business resulting from the electric lighting would be equal to 25 million cubic feet of gas; but actually it was not so much—being only 17 millions. The difference between the estimated and the actual quantities arose, in the first place, from the non-completion of the electric fittings in some of the military establishments; and, secondly, from the unexpectedly large increase in the gas supplied for private purposes and to the naval establishments. The rate of increase in the gas supplied for private consumption was 7 per cent., and to the naval establishments considerably more. At Sliema, where there was no electric lighting, they had had 21 per cent. increase; and a good many cooking-stoves had been fixed. It was believed that these rates of increase would continue; and when he mentioned that last year they connected no less than 98 new consumers, or more than double the number of the preceding year, it would at once be seen that there was considerable vitality in their Malta business, and that the recoupment of business which had been lost would be accomplished in less time than they anticipated. It was the great object of the Directors to replace that business; and their efforts were warmly supported by their Manager (Mr. J. W. Starkey) and his staff. Mr. Starkey might be trusted to lose no opportunity of advancing the interests of the Company. He had the entire confidence of the Board, and showed, in the administration of their affairs, not only energy but great discretion. At Corfu, matters were in much the same position as when last mentioned, except that they hoped they were one year nearer payment than they then were. The abnormal state of affairs there seemed to be improving; and they had repeated assurances of payment—in fact, with the restoration of law and order, and when they were in a position to enforce decisions of the Law Courts, the Company would no doubt get their money. Until then, all they could do was to watch patiently and closely. At Trapani, they had 4 per cent. increase; and matters had gone very well indeed during the year. At Marsala, they had had a small decrease—apparent, not real, as it was owing to the Company having got rid of unprofitable business. They had now the Manager at Marsala who acted for them at Corfu at the time of the transfer of that undertaking. He had not been there a complete year yet; but he had already shown a considerable improvement. If he could manage to work as well at Marsala as he did at Corfu, it would result in great advantage to the Company. The debt at Marsala was still unpaid; but it was not a matter of anxiety. It was, he supposed, as safe as anything of the kind could be; and it carried interest. It was also expedient that they should not increase the pressure they had placed on the Municipality for payment. For instance, the terms of the concession were susceptible of improvement; and they were trying to get them improved. But they had nothing definite to mention in that respect. A claim had been sprung upon them by the Italian Government in regard to their Sicilian stations for what they called registration fees. He said "sprung" upon them because it was only lately that they had received an application for such fees; and the Directors did not believe the Company were liable. But the question of their liability had been submitted to a competent authority at Rome; and he (the Chairman) thought the claim would have to be recognized. However they had a reduction of taxation at Marsala, and a reduction of rents at Trapani, which would nearly meet the claim, so that it would not be felt very much. But the Government talked about back payments. This was a matter about which they were in negotiation; for they did not admit any liability in respect of it. The whole of the works were in good order, with the exception of a gasholder at Marsala, which must be repaired this year; but this would be entirely a revenue charge. In the general revenue account, it would be seen that there was a further reduction of £375 in debenture interest. A new account had been set up called the "reserve fund." The Auditors thought—and rightly so—that this fund was now becoming of sufficient importance to stand by itself, and that it was very desirable the proprietors should know what sums were taken to and from it. Coming to the general balance-sheet, he said £10,603 had been taken from the old reserve account, and placed to the credit of outlay on the other side, which was merely a change of accounts. This was giving effect to one of the chief objects in the establishment of the reserve account, which was to include a sort of amortizement account; and therefore in making the change, they were doing right. As to the profit and loss account, it would be seen that coal had cost £502 less than in the previous year, although the price was 1s. per ton more. Salaries and wages were £71 less. Although in Malta they had economized to the extent of £119, the other stations took £48 more. The charges on street lights were £326 less; and maintenance had been reduced by £68. This figure would have been larger had it not been that they had made an addition to their coal storage at Trapani entirely out of revenue. The total expenditure was £1602 less than it was in the preceding year. As to the working, they had used 9787 tons of coal; and the average production of gas per ton was 10,292 cubic feet. They had sold 8746 cubic feet per ton; and the difference was 15 per cent., as against 14·96 per cent. in the preceding year. This seemed, on the face of it, that the unaccounted-for gas was slightly increasing; but it was really not so. Through their efforts to reduce the leakage, they had saved upwards of 2 million cubic feet; and the reason why the percentage looked large was because it was calculated upon a smaller quantity of gas. When it was considered that this amount included all that was used by the Company, all that was given away, and all that was taken in private lights, it would be seen that it was not all leakage. At the same time, every effort would be made on the part of the management to reduce the amount of leakage; but where the proportion of gas supplied for public lighting was so large as it was in their case, there would always be a large unaccounted-for item. The rental was £3047 less; and this nearly represented the loss of business they had sustained through the electric lighting under the Government. As to the residuals, one noteworthy feature was that the price of coke had improved. As a matter of fact, they had received £276 more than they did in the previous year, although they had used 1331 tons of coal less. There had been no improvement in the market price of tar and pitch; and consequently they had felt the effect of the smaller production—the decrease being £103. Fittings showed an additional profit of £196. This was very gratifying, because it bore witness to the growth of the business. There was also in this account a credit of £238 received as interest on the money paid on account of the Corfu transfer, and invested, as it was not yet required for the extinction of debentures. The accounts showed a profit of £9734, which was sufficient to pay the dividends recommended, and leave £827 to be carried forward. It was the intention of the Directors to place a substantial portion of this amount to the reserve fund.

Colonel James Le Geyt Daniell seconded the motion.

Mr. A. M. Paddon said he did not know of any instance in this kingdom where the competition of the electric light had assumed such proportions, or had succeeded in detaching such a large proportion of the business from the gas undertaking. He believed electricity was being sold in Malta at 6d. per unit. If that was so, it was being sold at a price less than in the City of London, where it was 7d. per unit. In the case of the Crystal Palace Electric Lighting Company, over 7d. per unit was charged; and, even at that price, they were working at a loss. They might take it for granted that they had seen the worst of this competition in Malta, and need not be in any way apprehensive respecting it. The success of electric lighting depended almost entirely upon the amount of arc lighting; and he should like to know the relation of the public business secured in this competition to the private business detached from the Company. He should be prepared to hear that the private business was very small, and the public business very large. He did not suppose the success of their opponents would have been so great if it had been a private concern.

The Chairman stated that the total amount of the private consumption lost up to the present time represented only £123.

The motion was unanimously carried.

On the proposition of the Chairman, seconded by Mr. Stephenson R. Clarke, dividends of 7 and 7½ per cent. respectively on the first and second preference shares, and 6 per cent. on the ordinary shares were declared, less the payments already made on account.

Mr. G. Fisher inquired the amount of the interest payable on the debentures; also whether some of the debentures could not be paid off out of the proceeds of the sale of the Corfu property.

The Chairman replied that the interest was 4½ per cent. The whole of the money received for the Corfu property, with the exception of that which had been invested, had been used for the purpose of paying off the debentures; and the remainder of the money would be so employed. The debentures, however, only fell due twice a year; and they had to wait for those times.

The retiring Director (Mr. J. Birch Paddon) and the Auditors (Messrs. R. Hesketh Jones and T. Guyatt) were re-elected.

Mr. H. Smith remarked that at the previous meeting reference was made to the conversion of the preference shares. As the Chairman had not mentioned the matter, he supposed the difficulties remained.

The Chairman replied that he was afraid so. Other companies of much longer standing and importance had the greatest difficulty in altering their stocks. During this session, an application had been made to Parliament for that purpose by The Gaslight and Coke Company; and they had had considerable difficulty in carrying the Bill. It had, however, now been passed; and the principle had again been admitted, but not without a good deal of questioning. In their own case, they had not the advantage of being able to go to Parliament, and ask them to pass a Bill for this purpose. He did not say the difficulties were insuperable.

On the motion of Mr. Joseph Cash, seconded by Mr. J. Westbrook, a hearty vote of thanks was passed to the Chairman and Directors, Secretary and Engineer, and the staffs at home and abroad.

ELECTRIC LIGHTING NOTES.

The Shrewsbury Town Council yesterday week instructed the Town Clerk to make application to the Local Government Board for sanction to a loan of £35,000, to enable them to purchase the undertaking of the Shropshire Electric Light Company, and to carry out extensions.

The Wolverhampton Corporation electric lighting undertaking has "turned the corner." During last year a profit of £589 was made after payment of interest and the amount due on the sinking fund. The deficiency on previous years' working was £1403; and to the reduction of this the profit made has been applied. The gross profit of the year amounted to £2833, which is equal to 6¾ per cent. The interest on the sinking fund represented about 5½ per cent., so that the net profit was 1 per cent.

Evidence as to the necessity for an extension of the Coventry electric-lighting works was laid before Mr. G. W. Wilcocks, one of the Inspectors of the Local Government Board, at an inquiry held by him in regard to an application by the Corporation for sanction to borrow £33,000. It appears from the statements made that the capital sanctioned and spent up to the present time is £33,300. By keeping a part of the plant in reserve, no more than 7500 lamps should be connected; or 5000 lamps burning at the same time. But as a matter of fact, the actual number connected is 9605, or something like 30 per cent. above what it should be. At the present time, the department has applications on the books for 552 additional lamps. The proposal is to expend the £33,000 in extending the works and mains, creating sub-stations, and carrying out a scheme of arc lighting. The works will have a capacity for 17,500 lamps.

Without a single dissentient, the Birmingham City Council last Tuesday agreed to the terms provisionally arranged by the General Purposes Committee with the Birmingham Electric Supply Company for the purchase of their concern; and the Committee were authorized to take the necessary steps for promoting a Bill in Parliament to give effect thereto. Although the members of the Council have endorsed the terms by their vote, they appear to be generally of opinion that they are paying pretty stiffly for the concern. The Company was originally floated with £5 shares; and it was not until after the proposal to purchase first came before the Council that the market price ran up to the figure at which the shares now stand—£10 10s., or thereabouts. Speaking at the Council meeting, the Lord Mayor (Mr. C. G. Beale) said they could not expect the shareholders to sell at a lower price than they could obtain upon the market; but, on the other hand, he could not justify the proposal to buy at £10 10s. by any calculation as to the intrinsic worth of the concern. All the Committee could say was that they could not get it for less than ten guineas per share. Last year the dividend paid was 5 per cent.; and he could only say that a business ought to earn considerably more than that to justify a premium of 100 per cent. As to the wisdom of the purchase, that depended upon the term which Parliament allowed the Corporation for the repayment of the loan. Taking forty-two years, the Corporation would be out of pocket the first year to the extent of between £3000 and £4000; being the charge for repayment in excess of profits earned. This was taking the accounts for 1897 as the basis of calculation; but if the accounts for 1898 came out substantially higher, this deficit would disappear. If, however, they had only twenty-five years in which to repay the loan, it would cost at first between £10,000 and £11,000 a year. The Committee had therefore stipulated that they should be permitted to "cry off" the bargain if Parliament gave them a less time than forty-two years. His Lordship also impressed upon the Council that they were not buying a gold mine, or anything of the kind. They were buying a concern that at the best could barely pay them for the first year or two; and if any increase of profit accrued, it must first be applied to the reduction of the price to consumers, so as to compete with private production, which, at present, as shown by the markets and Technical School, could be carried out more cheaply than by taking electricity from the Company. The question of depreciation must also arise; and they must face the necessity for reasonable provision under this head. He concluded by saying that, as the Company had undertaken the trial of a costly experiment which the Corporation in the past had not been prepared to face, it was only fair they should have a reasonable profit upon their enterprise. The shareholders of the Company last Friday confirmed the provisional agreement entered into for the sale of their undertaking, and showed their appreciation of what had been accomplished by the Directors by voting them £2000 for their services.

At the meeting of the Portsmouth Town Council last Tuesday, the electric light accounts came in for some severe criticism, which the Chairman of the Electric Lighting Committee (Alderman Ellis) did not condescend to answer. In commenting upon the accounts, he said he thought it must be very satisfactory to the inhabitants to know that while they were making a gross profit of £6795, they charged as low as, or lower than, any other town in the United Kingdom. It was this that brought up the critic—Mr. Gillett. He acknowledged that to make a profit of £6795 upon an invested capital of £112,000 was a return which a great many companies would be proud to show; but he asserted that the result existed only on paper. It required a little looking into. For years the Council had been told that they had one of the most wonderful electric light concerns in the country; and the Chairman of the Committee had declared that at the end of the year's working he should be in a position to hand over to the Chairman of the Finance Committee a cheque for £2000 towards the reduction of the rates. But the marvellous profit with which they were going to do so much was of little worth—in fact, he submitted that it was altogether illegitimate. Alderman Ellis had said there was no necessity for a depreciation account, as the sinking fund would be sufficient. Let them consider what that meant. They had a capital of £112,000, of which they had about £14,000 invested in buildings and lands. This left £98,000 invested in machinery, &c. The total amount put into the sinking fund during the space of four years was £9352, or £2338 per annum, which was equal to 43 years' purchase. But would Alderman Ellis say that his plant would last 43 years? Would it last half that time? He had admitted that the machinery had been worked far beyond its ordinary capacity. Under such circumstances, it would not last 15 years; and what money would he have for renewals or to meet any contingencies? Alderman Ellis had declared that it was not usual to make any arrangements for depreciation; but he (Mr. Gillett) contended that Manchester, whose electric light was installed a year before that of Portsmouth, had set aside £3307 a year towards the depreciation account, which now amounted to £10,000. Besides this, they had a reserve fund of £16,478. At Brighton, Aberdeen, and Bradford they had depreciation accounts. At Portsmouth they had to pay £4000 a year extra for street lighting and for the lighting of public buildings, which really meant that the small ratepayers had to pay 2d. in the pound for the benefit of those who indulged in the luxury of electric light. Was it fair to tax the whole for the benefit of the few? He most unhesitatingly said it was not. In order to show a miserable profit of £776, they had to pay about £4000 in other directions, with no allowance made for depreciation in the electric lighting plant. Surely they could not say that was a fair profit. In conclusion, he argued that the proper course for the Committee to adopt was to start a depreciation account—commencing with £2500 to £3000 a year for machinery depreciation; and consider the question of repairs as would be done by an ordinary gas company. Not until then could they talk about profit.

The Filey District Council and the Gas and Water Works.—The Filey Urban District Council lately renewed their offer to purchase the undertaking of the Filey Gas and Water Company, but it has been declined by the Company.

Reduction in Price.—A reduction in the price of gas has just taken place at Darwen. For lighting purposes, the charge has been reduced from 2s. 9d. to 2s. 6d. per 1000 cubic feet, making a uniform price for all purposes. The coin-meter supply has been increased from 25 to 27½ cubic feet for 1d.

Additional Capital for the Newcastle and Gateshead Water Company.—At an extraordinary meeting of the above-named Company last Tuesday, authority was given to the Directors to raise £500,000 of additional capital, under the powers conferred by the Act of 1894, by the creation and issue of 5 per cent. preference stock.

Acetylene Making at Cradley Heath.—The Midland Acetylene (Parent) Syndicate have established an acetylene factory at Cradley Heath. Some sixty hands are engaged therein; six electrical furnaces, actuated by two dynamos, being employed. The works are under the supervision of Mr. A. Halliday, the Superintending Chemist to the Syndicate.

The Bestwood Chemical Company, Limited, has been registered, with a capital of £4700, in £1 shares, to enter into two agreements with Messrs. R. & J. Dempster, Limited, and the Bestwood Coal and Iron Company, Limited, and to extract, manufacture, and deal in products from furnace gases. The first Directors—of which there are to be not less than two nor more than three—are Mr. Robert Dempster and Mr. John Dempster.

The Winding-Up of the Ashford Gas Company, Limited.—The winding-up meeting of the above-named Company took place last Friday, when all the accounts were cleared up, and the Company dissolved. The Liquidator (Mr. Frank Hyland) distributed to the holders of £10 shares a further sum of £1 per share, and to holders of £5 shares 10s. per share. These were final payments, and they brought up the totals received by shareholders to £17 for each £10 share, and £8 10s. for each £5 share.

The Workmen's Compensation Act and the Insurance of Gas Workers.—The Gas Committee of the Walsall Corporation have resolved not to insure at present against claims under the Workmen's Compensation Act; but they intend considering at the end of the year what portion of the profits shall be set aside to meet such claims. On the recommendation of the Gas and Electricity Committee, the Stafford Town Council have decided that guarantee policies for £2500 be effected with the Palatine Insurance Company for the office staff at a premium of 5s. per cent., and for the remainder of the staff at 6s. per cent.

Belfast Gas-Works Employees and Holidays.—As reported in the "Journal" last week, the Belfast Corporation at a recent meeting decided to allow the lamplighters a week's holiday per annum; and on the same occasion the Gas Committee were instructed to consider whether this privilege could not be extended to the general gas workers. At the meeting of the Committee on Friday, the 10th inst., Mr. Murray Davis submitted a resolution to the effect that, for the present, no holiday should be granted to any of the workmen under the control of the Committee; and, according to the "Belfast News Letter," it was carried with one dissentient.

Free Cookery Lectures and Railway Fares at Pinner.—The Pinner Gas Company have arranged to hold a series of free lectures on cooking by gas, by Miss Helen Edden, using one of Messrs. Fletcher, Russell, and Co.'s ranges, at Ye Cocoa Tree, High Street, Pinner, from June 28 to July 1 inclusive. In order to give the residents of the suburb of Northwood, where there are 60 or 70 ordinary, and as many prepayment consumers, but no suitable lecture-room, an opportunity of seeing the economy, cleanliness, and perfect results to be obtained by the proper use of a gas-range, the Company will (on production of the return half of the railway ticket at the lecture) pay third-class return fare from Northwood to Pinner to any lady or gentleman who attends any one of these lectures. The arrangements will be under the supervision of the Manager, Mr. Eli Bull.

METROPOLITAN WATER SUPPLY COMMISSION.

Twenty-fifth Day—Monday, June 13.

(*Viscount* LLANDAFF, *Chairman*, *Sir* JOHN E. DORINGTON, Bart., M.P., *Sir* G. B. BRUCE, M.Inst.C.E., *Major-General* A. DE COURCY SCOTT, R.E., *Rt. Hon.* J. W. MELLOR, Q.C., M.P., *Mr.* A. DE BOCK PORTER, C.B., *Mr.* H. W. CRIPPS, Q.C., *and Mr.* R. LEWIS.)

The sitting took place at the Guildhall, Westminster.

The following Counsel are engaged: Mr. POPE, Q.C., and Mr. CLAUDE BAGGALLAY, Q.C., for the New River Company; Mr. LITTLER, Q.C., and Mr. LEWIS COWARD for the Kent Water Company; Mr. PEMBER, Q.C., for the Lambeth, East London, Grand Junction, and West Middlesex Water Companies; Mr. RICKARDS for the Chelsea Water Company; Lord R. CECIL for the Hertfordshire County Council; Sir JOSEPH LEESE, Q.C., M.P., for the Kent County Council and Kent Local Authorities; Mr. BALFOUR BROWNE, Q.C., and Mr. FREEMAN, Q.C., for the London County Council; Sir R. NICHOLSON for the Middlesex County Council; and Mr. GABRIEL P. GOLDNEY (Remembrancer) for the Corporation of the City of London. The Southwark and Vauxhall Water Company are represented by Messrs. BIRCHAM AND CO.

Mr. *R. M. Littler*, C.B., Q.C., examined by the CHAIRMAN, said he was Chairman of the Middlesex County Council and of the Court of Quarter Sessions for the county. He did not regard the Middlesex County Council as in any sense a political body. There were some peculiarities of administration, which from a financial point of view pressed heavily on the county, and made it necessary for them to exercise the greatest economy and avoid speculative schemes. The population, which in 1891 was 559,392, was now over 740,000. The rateable value was £3,180,633 in 1891; £3,628,742 in 1896; £3,672,593 in 1897; and for the present year, £3,898,000—the two last sets of figures showing an increase in one year of over £220,000. There were no boroughs in the county; the Local Authorities consisting of 33 Urban and Rural District Councils. The increase in population and rateable value had been very rapid indeed—probably more rapid than in any other Home County. Practically there was a water supply throughout the whole county. There had been two conferences of the County Council and the Local Authorities on the water question—one on Feb. 5, 1895, and the other on Jan. 26 last. At the former, a resolution was passed according to which the District Councils agreed that their interests might safely be entrusted to the Middlesex County Council, as regarded the course to be adopted in dealing in Parliament with the several Water Bills being promoted by the London County Council; and that the District Councils be recommended to present petitions to both Houses of Parliament in opposition to the Bills. The other resolution approved of the past action of the Middlesex County Council, and left in their hands the duty of representing the whole county before the present Commission.

The CHAIRMAN: Can you tell us what the policy of the Council and of these different Local Authorities is with regard to the purchase of the Companies?

Witness: The view we entertain on the matter of purchase is that it cannot possibly do us any good, and may do us a great deal of harm.

In further examination, witness said there were three alternatives before the county—either to be included bodily with London, to take a supply in bulk, or to have handed over to them a share of the sources of supply, together with the necessary mains for distribution. Either of these courses would be injurious to Middlesex. Only a portion of the county was supplied by Metropolitan Water Companies; these being the East London, Grand Junction, New River, and West Middlesex Companies. The interest of the East London Company was very small; being, in 1896, in respect of only 5027 persons in Tottenham. In 1896, the Grand Junction Company supplied 147,787 persons; the New River Company, 180,368; and the West Middlesex Company, 130,289. The water-supplying bodies in the county, with the populations supplied, were: The Enfield Urban District Council, 34,600; the Tottenham Urban District Council, 56,977 (a portion only being supplied); the Uxbridge Urban District Council, 8636; the Barnet District Gas and Water Company (who also supplied in Herts), 30,150; the Central Middlesex Water Company, 747; the Colne Valley Water Company (who also supplied in Herts), 23,660; the South-West Suburban Water Company (who also supplied in Surrey), 37,100; and the Rickmansworth and Uxbridge Valley Water Company (who also suppled in Herts), 15,350—a total of 267,220, which figures were now considerably larger. Therefore about one-third of the population were supplied otherwise than by the Metropolitan Companies. The five local Companies had Acts of Parliament; the three Local Authorities supplying under the powers of the Public Health Act of 1875. He thought Enfield, also, had a Provisional Order to take land compulsorily. The Companies, other than the Metropolitan Companies, supplying in Middlesex had a monopoly of supply.

The CHAIRMAN: The view that has been laid before us by the London County Council was that in London competition had been intended and enacted by Parliament; but inside, and even outside, London I understood it to be conceded that the Metropolitan Water Companies have practically a monopoly in their district?

Witness: I believe they have inside, too.

Sir JOHN DORINGTON: Is it not the case that, under the Public Health Act, no public authority can interfere with a water company unless the company are unable or unwilling to supply?

Witness: That is so.

That would not prevent another company getting an Act of Parliament to enter the same district?—Not if Parliament would grant it.

In answer to further questions, witness said that wherever a water company, authorized by Parliament, were supplying, and continued to supply, water satisfactory in quality and quantity, local authorities would not spend money to compete. The opinion of the Middlesex County Council was shown by the report of the Parliamentary Committee, presented in July, 1891, on the London Water Commission Bill and the Metropolis Water Supply Bill of that year. The report stated that the Committee were of opinion that the interests of the county required that, in any dealing with the question of the London Water Supply as it affected Middlesex, provision should be made against the sinking of new wells and the deepening of existing wells in the county; that provision should be made for limiting the abstraction of water for London, or any other external supply, from Middlesex; that no scheme would be acceptable to Middlesex which did not provide for no further water being abstracted from the Middlesex area, and for the independent control by Middlesex, from the beginning, of their sources of supply. This report had been approved time after time since; the last occasion being in December, 1896. What Middlesex desired was that sufficient water should be left in the Thames for Middlesex for all time. The water came to Middlesex before it reached London; and Middlesex contended that they were entitled to take what they required before anyone else. They did not want to go to Wales. They would not object to Surrey taking what they wanted.

The CHAIRMAN: And Buckinghamshire could advance a claim which would be prior to yours, and so on?

Witness: Yes. All the counties, but for the extraordinary claims of London, could get sufficient water from the Thames.

Mr. CRIPPS: You think that every district situated nearer the source of the river has a better claim than the Londoner?—Quite. This was emphasized in the case of the Thirlmere scheme; the Manchester people being put under obligation to supply everybody on the line of aqueduct. By "no further water being extracted from the Middlesex area," Middlesex mean that no more water should be taken from the Thames or more wells sunk in the county; they protest against being denuded of water in their own area, in order to supply outside—that they should be left short, and thereby compelled to get water from a distance, while the water below their feet was being taken from them. They do not mean that no more water should be obtained from Middlesex for the county itself. At present, the eight Companies have power to take 185½ million gallons a day from the Thames; in case of purchase I would respect this right, but allow them to take no more. The purchase of the Companies' present right of abstraction from the Thames, by itself, would not put Middlesex at any disadvantage.

Mr. BAGGALLAY, on the question of competition, said the Public Health Act did not apply to London; but section 150 of the Metropolis Management Act, 1855, expressly provided against the Metropolitan Board of Works (now replaced by the County Council), or any District Board or Vestry, undertaking any works for domestic or trade supply within the Metropolis. This applied to the whole of what was now the County of London.

The CHAIRMAN (to witness): As I understand, you object to purchase by anybody?

Witness: By anybody.

Why do you say it is bad in this particular case?—We feel, supposing there were a Water Trust, that our representation must be almost infinitesimally small upon it; and we know it had been agreed between London and ourselves that our interests in water matters are antagonistic. That being so, we should practically lose control of our water supply; and it would get into the hands of persons not so interested in our county as we are.

Cannot you suggest some constitution of a Water Trust which should be perfectly impartial and fair between all the Metropolitan counties, including London?—I have had a good deal of experience of mixed local authorities; and I have never found one that was. I think the general experience is that sooner or later disputes will arise between them which you can never foresee.

Suppose you have two representatives of each of the counties, representatives of the Thames Conservancy, of the Local Government Board, and of the Board of Health, with possibly an expert or two added. Why should such a Trust, purchasing and managing the water supply for the whole of the London water area, be unfair to anybody?—The first answer is, I think, that the origin of this is a desire to satisfy the people of London. I do not believe it would satisfy them.

That has nothing to do with us?—I never contemplated such a "Council of Perfection" as that—that the people were not to be represented, to a certain extent at all events, according to population and taxation. It would not be impossible for such a Board to be set up; but it would not be far from impossible in practice. Middlesex desire to be left alone.

What would be your opinion about the State being the purchaser?—I should infinitely prefer that to any Trust whatsoever, if it is to be done at all. Having regard to the admirable work done by the Civil Service, I would much rather have the matter in their hands.

But that would be extremely unpopular?—Your Lordship asked me the question; and I have nothing to do with popularity or unpopularity.

Mr. MELLOR: That would transfer the control from the County Council or the purchasing authority to the House of Commons?

Witness: Absolutely.

The CHAIRMAN: There are many matters, which elsewhere are matters of local control—the police for instance—which in London are under Government?

Witness: Yes; there cannot be a better illustration than the police. The solution suggested would be most effective as far as supply was concerned. If the London County Council were the purchasing body, the tendency in case of scarcity would be to benefit London at the expense of the Outer Ring. This danger would be removed if the purchaser were the State.

If I may sum up your view, I understand it to be that you do not want purchase by anybody?—Certainly.

If there is to be purchase at all, what you object to most strongly is purchase by an independent county authority, such as the County Council of London?—Certainly.

What you next object to most is purchase by any Water Trust in which any one Local Authority should have a preponderating voice?—Yes.

You object less to purchase by a Water Trust in which there should be no preponderating voice, if it is by any Local Authority, and still less if it is by the State?—Exactly.

On the other hand, you think the two last mischievous, because they interfere with the existing *status quo*, and would not satisfy anybody?—Yes; in addition to which they would be very costly.

By Sir JOHN DORINGTON: In case of purchase by an Outside Authority, a rate-in-aid might be necessary; and Middlesex objected to anyone except their own Authorities or the State rating Middlesex people. The Companies in Middlesex were charging very low rates. Following also on the suggested reduction of the charges of other Companies, say,

those of the Lambeth Company, which dealt exclusively with South London—there might have to be a rate-in-aid; and it would be very serious if it were levied in Middlesex.

By Mr. De Bock Porter: He saw no great injustice in the water-rates in different parts of London being different. No one complained that Bradford charges were higher than those at Leeds. The same inequalities existed in other rates.

By the Chairman: The more he looked into the financial results of purchase, the more he was satisfied that it must be expensive.

Witness then handed in a table of the rates charged for domestic purposes by the Grand Junction, New River, and West Middlesex Companies, and twelve provincial water undertakings under corporate management, in each case in respect of houses from £10 to £200 rental. The corporate undertakings were selected because of the largeness of their charges—which were, for houses of equal value, in every case, higher than those of the companies—the object being to show that corporations were not exempt from high charges at times. As a matter of fact, witness continued, there were very few corporate undertakings in which the charges were much below those of the London Companies. He did not think corporate management was likely to be as economical as private management. Purchase was much less desirable now than in 1880—seeing that then there were no County Councils, no borough of Croydon, no large Local Authorities, that none of the Local Authorities then in existence had their own water supplies, and the various small Companies he had mentioned (if in existence) were in their infancy. He had worked out, in several ways, what would be the result of purchase by arbitration; and any one of them, unless the arbitration were on totally new lines, would lead to a price which would certainly increase the present cost of water or necessitate a rate-in-aid. He hoped Parliament would not allow a special arbitration clause, such as the County Council had suggested, to deprive people of their property; but unless this were done, he was fearful the price would be very large and very disadvantageous to Middlesex. He saw no reason for not holding the arbitration under the Lands Clauses Act—why they should differentiate between London and any other place, simply because London was large. The number of years' purchase allowed for undertakings of this kind had recently increased greatly; 28½ years, with 10 per cent. for compulsory sale, being very common now. On this basis, the value of the Companies' present income of £1,166,621 came to £36,000,000, allowing nothing for back-dividends or prospective profits; and this was so much below the present market value—£39,000,000—that he should infer that the arbitrator might very fairly give more.

By Mr. De Bock Porter: If there were a large unremunerative expenditure in the near future, that would operate in the mind of the arbitrator, and reduce the price; but if the expenditure were going to be unremunerative for only a certain number of years, he would merely make a discount allowance in respect of it.

By the Chairman: He knew of no case in which compulsory purchase of undertakings such as those of the Water Companies had occurred, except under the Lands Clauses Act. He failed to see any important particular in which control was needed further than it existed at present. There was already considerable control over everything except charges; and he did not see how control over the charges could become possible. He did not recollect that in 1852 a Committee of Parliament accepted a scale of maximum charges on a pledge by Serjeant Wrangham that the Companies would not use them to raise any greater income than they were then receiving.

The Chairman: It seems to me a strong argument against going on allowing the Companies to make an unlimited income out of the increased rateable value of London.

By Mr. Cripps: He thought the suggestion of Sir John Lubbock that two representatives of the people should sit on the Board of each Company would weaken the existing control over the Companies. They would always be in a minority.

In further examination by the Chairman, witness said he had considered the question of dividing the works in case of purchase, of the West Middlesex and Grand Junction Companies. One of the Companies might hand over to the other all their area outside London; and this Company might remain in existence in order to supply the area of both Companies in Middlesex. From an engineering point of view, he was informed that there would be no difficulty in re-arranging the works in this way. As to the difficulty that might arise when Middlesex had grown so as to exhaust its present supply, witness said it was very doubtful if the population would continue to increase as rapidly as had been calculated; and if it did become necessary to go to a distance—say, Wales—for a fresh supply, it was certain London would be in the same position. If a proper use were made of the Thames, it would not suffer by having sufficient water for London taken from it. Sir Alexander Binnie seemed to think this, though he said the cost of the requisite storage would be enormous. Then arose the question whether Sir Alexander's estimates in this respect were not very excessive. Witness would certainly say they ought to exhaust the Staines scheme, or get near that point, before undertaking the enormous expense of going to Wales. He discredited entirely the assertion that the Thames was likely to become more polluted. He felt no doubt regarding the ability of the Companies to meet the increased charge resulting from the execution of the Staines scheme. If, when the necessity for going to Wales arose, the Companies declined to undertake the work, Parliament might provide that the County Council should purchase the undertakings as those of Companies failing in their duty, and consequently at a very low price. If the County Council did not do this, it might be done by the State; and with the same penalties held over them, the Companies might be required to undertake the work in good time, so that it might be ready when required. Middlesex would object to amalgamation among the Companies taking place, except perhaps between the West Middlesex and Grand Junction Companies. The only advantage would be the saving in administrative charges.

By Mr. Baggallay: If a Water Trust were created, it would have very large power of employing labour; he thought it very undesirable that elected bodies should be the direct employers of large numbers of workmen. If special instructions were inserted in the arbitration clause, the arbitrator would be involved in difficulty, because particular weight would have to be given to the special instructions, which would be hampering. He knew of no case, except that of misbehaviour, in which Parliament had said something for what was ordinarily included under the head of compulsory sale or prospective value should not be given. Owing to the penalties, not only of £200 and £100 a month for failing to give a constant supply, but also of £2 a day to every person in the district for failing to give the ordinary supply, until a company were absolutely bankrupt it must be to their interest to look ahead, and make as effective provision as any public authority would do. But for the fact that Parliament had of late purposely only given the Water Companies such powers as were necessary to go on for short periods, he had no doubt that by this time they would have made very large provision ahead.

Mr. Baggallay, in reply to Mr. Cripps, who asked for information as to the line the Companies were going to take, said they might assume that the Companies were opposed to the purchase of their works; that they would try to show that no further, or little further, control was necessary; and that they did not think purchase would be in the interests of the consumer.

Mr. Littler's examination by Mr. Freeman, was postponed, and the Commission adjourned.

The twenty-sixth sitting of the Commission was held yesterday, at the Guildhall, Westminster—Lord Llandaff presiding. Mr. William Leete, the Vestry Clerk of St. Mary Abbot, Kensington, the first witness called, said the Kensington Vestry had on more than one occasion expressed their disapproval of the proposed purchase of the undertakings of the Water Companies by the London County Council, and had favoured rather, as as alternative policy, the promotion of legislation by which a central body representing the ratepayers of the whole of the area of supply of the Companies should be vested on behalf of the consumers.

SOUTHWARK AND VAUXHALL WATER COMPANY.

The Half-Yearly General Meeting of this Company was held at the Offices, Southwark Bridge Road, on Tuesday last—Alderman Sir H. E Knight in the chair.

The Secretary (Mr. Montague Watts) having read the notice calling the meeting,

The Chairman said it always afforded the Board pleasure to meet the shareholders, whether they had a good report or a bad one, though he was happy to say he had not yet met them on an occasion when they had what might be called a bad report. That day, he was pleased to say, the report was of a very excellent character, because it showed undoubted vitality in the progress of their undertaking, and enabled them to make a very satisfactory increase in the dividend that they had been able to pay for some three or four years past. He would not have to detain them long, because last year he dealt very fully with many questions affecting the management and future of the Company. It was thought that the figures he then placed before them were of such importance as to justify the Board in having them printed; and a copy of them had been sent to the shareholders. He trusted that they considered those figures satisfactory. He never liked to have a single word of difference with any of the shareholders; and so he was particularly anxious that the one or two, who were evidently acting under misconception, should have the true facts of the case laid before them. They would recollect that the figures showed the Company to be one of the best managed, and one of the most prosperous companies in the city of London, and also that their works were in the most perfect condition. It was very gratifying to him to see—what no doubt many of them had noticed—that in connection with the evidence given at the inquiry now proceeding before the Royal Commission, a table was handed in by Mr. Haward, Accountant to the London County Council, which set forth that the cost of management per million gallons was: In the Southwark and Vauxhall Company, £387; in the East London, £539; in the Lambeth, £610; in the Grand Junction, £792; in the Kent, £828; in the Chelsea, £895; in the West Middlesex, £988; and in the New River, £1247. They had in these figures high testimony from an independent source, as to the manner in which the Company was managed, so far as the expenses were concerned. They would notice the first paragraph in the report stated simply that the accounts had been duly certified by the Auditors of the Company. The paragraph generally ran that the accounts had been duly certified by the Government Auditor and the Auditors of the Company. They had not this time a certificate from Mr. Stoneham, the Government Auditor—not because he was at variance with the Company's Auditor as to the correctness of the accounts, but because there was a section in their Act of Parliament of 1896 which he was not quite clear upon. It affected certain expenses which the Board held to be capital expenditure, but which the Government Auditor thought might be otherwise. Therefore he wished to take the opinion of Counsel on the point, and preferred not to attach any certificate to the accounts at present, but leave it to the Board to do as they were entitled to do for three or four half years under their Acts of Parliament—namely, to issue accounts simply approved by the Company's Auditors, and to pay a dividend. The matter at issue was not any difference with regard to the correctness of the accounts, but simply a question of the interpretation that should be put upon certain clauses in their Act of 1896. The next paragraph told them, as the Board had done for many years, that every attention had been given to that section of their business which had reference to the keeping of the plant in repair. He believed the plant was in perfect and most substantial repair, and that everything that had been said to the contrary—and something perhaps had been said in certain evidence placed before the Royal Commission—would be thoroughly refuted at the proper time. As they were aware, the Company had a Bill in Parliament. He could only say, regarding this Bill, that it had been most successfully combated through the House of Commons, and through a Committee of that House. Of course, they met with most determined opposition from the London County Council, the same as he had had, he might say, the pleasure of meeting now for a good many years in the Company's interest; and the County Council did all they possibly could to prevent the Company from obtaining the powers requisite to enable them to perform their duties. However, they had been so far perfectly successful; and the Bill had now been read the third time in the House of Commons, and had been sent to the House of Lords.

He believed that when it went before a Committee of that House, the Company would be equally successful in convincing them that they were asking for nothing but what was absolutely necessary to enable them to perform their statutory duties. The works in course of construction pursuant to the Act of 1894 and previous Acts, were making excellent and rapid progress. He would like the shareholders to pay a visit to their works at Hampton, and see the new buildings they had erected and the magnificent series of works they would have before long at that station, extending over a mile in length along the river bank. In two or three years, when all was completed, it would be one of the most magnificent stations possessed by any water company in the world. The Company now supplied a total of 121,421 houses, 94 per cent. of which were on constant supply. Turning to the accounts, he said that in No. 2 capital account they would see the Company had expended £38,659 over and above the capital they had in hand. Consequently, it became necessary now to make a furthur issue of debentures. The Board would, therefore, issue immediately £100,000 of "B" debentures, under their Act of 1894. These the shareholders would have the opportunity of applying for; and he hoped they would do so as well as they did on the last occasion, when the Company received £104 10s. per cent. for 3 per cent. debentures—thus showing the highly satisfactory position they held in the money market. There were a few details in the accounts to which he might call attention—not that they were of any great importance, but they would enable him to give a little information which would be interesting, he hoped, to the shareholders. As to the item of maintenance, they would see that the total was £47,975, against £48,022 in the corresponding period of 1897. Those amounts were practically the same; but still there were differences in the various items making up the total to which he should like to refer. Under the head of maintenance and repair of mains, &c., the amount for the half year under review was £9320, against £10,394 in the corresponding period of last year. The reduction was due to the fact that, during last winter, there was an entire absence of frost; and consequently they were at no outlay for bursts, stand-pipes, or things of that sort, which naturally increased the expenditure during a severe winter. They might say the saving of £1000 in this item reflected no credit on the Directors. That might be so; but it at any rate showed that the Board could not altogether control the circumstances that affected the Company's business. In pumping and engine charges, there was also a saving of £1000, due to cognate causes. The payment to the Thames Conservancy stood in the accounts at £3116, against £2347 in the corresponding period. This was because, under their Act of 1897, they had to make the Conservancy a first payment in respect of the increased quantity of water which the Company were allowed to take under that Act provisionally, but which, under the Bill now before Parliament, they were seeking powers to take permanently. Then, under the head of management, he did not think there was any item calling for attention, except the law and parliamentary expenses, which amounted to £524, against £2458 in the same period of the preceding year. The total saving in respect of the management account was £1934, and was entirely due to the diminution of the amount paid in respect of law and parliamentary expenses. To the other side of the account he could refer with great pleasure, because the figures were highly creditable to the Company, and must, he thought, be satisfactory to the shareholders in every respect. Against the balance brought forward to provide for allowances for empty houses, bad debts, and overcharges, they had a saving of £1452, against £821 in the previous year. This meant that their revenue was more correctly estimated. Their collections were better and better; and the percentage of loss got less and less. The Board took full credit for this, because it was due to the management that they had so successful a result. The next item—that of water-rents—amounted to £126,483, against £121,595 in the corresponding period of the previous year. Such an increase as this was highly satisfactory, because it showed the vitality and soundness of the undertaking. If they took this increase, together with the saving of £1934 under the head of management, they had a total of nearly £7000, which was the difference between the £69,193 to be carried to dividend and interest account for transfer of profits, and the sum of £62,000 which was carried to that account in the corresponding period of the preceding year. They brought forward from the last account £44,633, out of which a dividend was declared for the half year ended Sept. 30 at the rate of 6 per cent. on the ordinary stock and 6 per cent. on the "D" shares, which left a balance of £13,746 to be carried forward. This was against the balance in the corresponding period in the previous year of £247; so the shareholders would see what enormous progress they had made in their reserve in that one year. And, of course, during the half year, they had to provide for an increase of interest in respect of the issue of £100,000 of debenture stock last year. Deducting that and the dividends paid on the preference stock on Dec. 31, 1897, and March 31, 1898, they had a balance left available for dividend of £47,344, against £28,328 in the corresponding period of last year. This would enable them to pay a 6 per cent. dividend, amounting to £30,887, and leave £16,457 to be carried forward to the credit of the next half year, against £13,646 last time. Some of them might suggest that, as they had earned more than 6 per cent., they should pay more. He thought, however, that the shareholders generally would approve the wise precaution which the Board had taken hitherto of keeping money in hand to meet any contingency that might occur. For the past few years, there had been a steady increase in the dividend; and unless anything unforeseen happened to upset the calculation of figures he had in his mind, he hoped he might be able to congratulate them very shortly on being able to recommend a dividend of 6½ per cent., as in 1892. He concluded by moving the adoption of the report and accounts.

Mr. C. M. VIALLS seconded the motion.

Mr. W. B. JEFFRIES congratulated the Directors on the favourable report placed before the meeting. He was very sorry that the Royal Commission with reference to the water question was still going on, as it necessarily entailed a lot of expense on the Companies, who were bound to take steps to protect their interests. He thought the time had come when there should be an uprising among the shareholders of the Water Companies against the action of the London County Council in harassing the properties. He felt sure that if they were to combine they could cause a little trouble to some of those men on the Council who, he thought, were only seeking to get possession of the water-works for the sake of the extra patronage it would place in their hands when the time for their re-election came round. He should be pleased to hear from the Chairman an expression of opinion as to the desirability of houses being supplied with cisterns where there was a constant supply of water. He next dealt at some length with the remuneration and conditions of service of the Company's collectors, among whom, he said, there appeared to be certain grievances; and he asked that the Board might take their case into consideration.

The CHAIRMAN, in reply, regretted that Mr. Jeffries had seen fit to go into various matters respecting the employment of the collectors at a meeting of shareholders. It only made the position of the Board more difficult in managing the concern, to create the impression that a section of their employees had better friends in the shareholders than in the Board. He could assure them that any such idea was perfectly contrary to the fact. The collectors were paid by commission; and their districts were limited to a number of houses which it was in their capacity to attend to. That they could do the work allotted to them, and that they did do it, was proved by the success with which the rents were got in. The collection of 99 per cent. of the possible amount was a splendid result; and he might say that, besides receiving a handsome income for anyone in the position they occupied, the collectors were rewarded for discovering charges which should be made but were not, and for any other extra services that they rendered. The present system of collection was one which took a long time to elaborate. But it had been proved by actual experience that it was founded on sound principles; and he was ready to admit that it was to the result of the collectors' efforts that much of the success of the Company was due. With regard to the question of cisterns, he said that it was highly important that every house should have one capable of a storage of water sufficient to last 48 hours. A breakdown of the machinery or the bursting of a main might otherwise leave the inhabitants of a house for two or three days without one of the first necessaries of life. The alleged water famine in the East-end, about which there was so much hue-and-cry some time ago, was simply due to a number of small houses there having been built without cisterns. If Mr. Jeffries wished for any further information with regard to the conditions of service of the collectors, he would be able to obtain it on application to the Secretary; and he trusted in future that this course would be adopted, instead of any shareholder making himself the medium of the men's grievances at a meeting of the Company.

The motion was agreed to unanimously.

The CHAIRMAN then moved the payment of dividends at the rate of 5 per cent. per annum on the preference stock and 6 per cent. per annum on the ordinary stock and class "D" shares.

Mr. VIALLS seconded the resolution, and it was carried.

The proceedings terminated with a vote of thanks to the Chairman, the Board of Directors, and the officials.

GRAND JUNCTION WATER-WORKS COMPANY.

The Ordinary Half-Yearly General Meeting of this Company was held at the Offices, South Molton Street, last Wednesday—Mr. F. TENDRON in the chair.

The SECRETARY (Mr. J. Goodwin) having read the notice convening the meeting,

The CHAIRMAN observed that the effect of the frost of February, 1895, had been so marked upon the finances of the Company that he thought it was desirable to institute some sort of comparison between the working of the past year and that of the year preceding the frost—to March 31, 1894. He found that, as compared with that year, their earnings had increased by £17,560; but during the same period their rates and taxes had gone up by £5093, and the maintenance of their works and additional pumping by £7770. The rise in their normal receipts and expenditure had therefore left a net increase of £4700 in the earnings for the four years. This meant that if they had had no exceptional expenditure, they would be in a position to pay in dividends £4700 more than they were able to pay in the year to March, 1894. Unfortunately, they had had greatly increased expenditure, which they had called "special." The outlay on account of the frost cost them directly nearly £20,000; and about £20,000 had been spent during the period in lowering the mains which froze during the extreme cold. This work they understood would be finished by next month; and they would have lowered more than 80 miles of mains. In addition, they had spent about £5000 in opposing the Bills brought upon them by the action of the London County Council, and also in resisting what they considered to be unjust assessments by the parochial authorities. They, therefore, had altogether, during the four years, special expenditure of £45,900 which had been borne by revenue. It was quite clear, not only that they could not have an increased dividend, but that this money, to a large extent, had had to come out of the rate they had been previously paying; and so for some years they had only been having 7½ per cent., instead of the 8½ per cent. they received for many years previously. Moreover, from the position of the Water Companies, he could not hold out any expectation of an increase. Even if they earned a little more, it would be extremely impolitic to pay it, because not only had they now to provide for the cost, which would be gradually increasing, on their proportion of the capital for the Staines reservoirs, but they had also had to raise a large amount of new capital to meet the expenditure required to ensure the sufficiency of the supply and the purity of the water. During those four years they had raised capital—and he would include with this the amount they were now raising—to the extent of £100,000; £30,000 of it being in debenture stock, and the rest in 7 per cent. ordinary shares. The amount they would receive for the whole of this would be £181,816; so that they had raised this £100,000 at an average of about 3½ per cent. Now, having completed this large exceptional expenditure, and bearing the full rate of interest on the money they had raised, or £6100 a year, let them see whether they would be able, as far as they could judge from the normal increase in their district, to meet the increasing charge that would come upon them in connection with Staines. The whole interest that they would have to pay on their one-third ownership of the property was £12,000 a year. As the works progressed, they would have to find more and more money to pay to the contractors. At present the Staines Authorities had raised only a little over £200,000; but they would probably have to raise within a very short period another £250,000.

They saw clearly, however, that if they had been able to face, by the sacrifice of receiving a lower dividend, an expenditure averaging for the four years upwards of £11,000 a year, they need not feel much uneasiness that during the next four or five years they would be able to meet a charge which, at its very maximum, would not exceed £12,000. Personally, therefore, he had no uneasiness as to their being in a gradually improving position until the water was let into their new reservoir. But the moment this was done, they came, in addition to the £12,000, upon a sinking fund of £8000 a year—a fund which they considered an abomination, and most unjust in every way. They would then have to be prepared, out of their existing profits, to bear a charge of £20,000 a year for interest and sinking fund. This period, however, was some distance off; and he did not think they need trouble themselves very much about it at present, seeing that there was a normal increase of something like £4000 a year in their gross receipts. Now that they had provided, as he trusted, nearly all the capital that was needed, he did not see that they had to look forward to increased charges to any large amount. He therefore hoped that during the four or five years they would be able to put by sufficient money to carry them through the first two or three years when the Staines reservoirs were in operation; and these would be their most trying years. It would be a great point if it was possible to reduce the consumption of water to avoid waste. Mr. Hunter (the Engineering Director) had had his attention very closely called to this, and in former years Mr. Fraser also. They were very rigid in stopping waste wherever they could; and they were certainly enforcing their rights in almost every case. They were called upon to do so much for the public, that they thought that where they were entitled to make a charge they should do so, and enforce its payment. Well, what was their position in the future going to be, because one of the most important questions was not only where was the water to come from, but what would the cost be of securing that water—whether from a distant watershed or by systems of reservoirs in the Thames Valley? They were in as good a position as almost any Water Company could be. He had the assurance of their Engineering Director that when the present Staines reservoir was completed they could have a supply for the estimated population of their district, even upon the exaggerated scale that was submitted to Lord Balfour's Commission, of 45 gallons per head per day up to 1937. Now, this was a most important position for them to be in, because it made them independent of the cost of further reservoirs, or of having to bear the burden, or a portion of the burden, directly, of bringing the water from another source. But as between themselves and the Royal Commission now sitting, a position of that kind, although satisfactory, would not, he thought, weigh with them. They would not regard the position of each individual Company, but only the requirements of London as a whole; and it would be an unfortunate thing in the interests of the Water Companies, if the latter were not prepared to give evidence before the Commission to show that they were willing, on certain terms, to effect a junction between the mains of all the Companies, so that there should be no risk of any portion of the London district running short of water while there was abundance elsewhere in the Metropolis, and were willing to incur joint responsibility in undertaking that, whatever the necessities of London might be in the future, they would be jointly and severally responsible that those wants should be met, whether by reservoirs in the valley of the Thames or by bringing water from a distant source. He did not know that a joint responsibility would be a very serious matter for the Water Companies, as money could be raised very much cheaper. Their own average rate of raising money had been of late, as he had said, 3½ per cent.; but it was perfectly certain that if there was a joint and several guarantee of all the Companies, it would be raised almost, if not quite, as cheaply as by the London County Council. There could be no risk for the people who provided the money, and none for the guaranteeing Companies; and therefore he saw no reason why this joint responsibility should not be incurred. Another point that it would be essential for the Companies to bring before the Royal Commission, unless they wished some independent power introduced that should compel a Company to do the work that was necessary, was that there should be a means of enforcing on any particular Company that had not a sufficient supply the taking of the requisite steps to ensure that supply within the necessary time; because these works were not to be carried out in two or three years. Works of such magnitude might have to be undertaken several years in advance. There were two or three points on which it would be most unreasonable to ask the Companies to take this heavy responsibility without giving them an adequate return. Suppose the Welsh scheme were adopted, and it was necessary to spend £16,000,000 of money, when the return for this money was only to come after a long lapse of time, it would be monstrous to imagine that the Water Companies, out of their existing revenues, were to bear the current interest. It should be an accumulating capital charge, but to be liquidated during a term of years out of the revenues received from the increasing population. There was one very important point that had been urged strongly before the present Royal Commission. It was urged by the officers of the London County Council—they had been pressing it most strongly upon the Royal Commission—that the reservoir capacity should be sufficient to meet the requirements of London, and yet allow 250 million gallons as a minimum to pass over Teddington Weir day by day. The evidence of the Thames Conservancy and of the engineers before Lord Balfour's Commission was 200 million gallons a day; and he thought engineers would tell them that, so far as the navigation of the river was concerned, much less than 200 million gallons a day would be sufficient. Why, then, should there be 200 million gallons? and why should it be necessary that there should be 50 million gallons more? An additional 50 million gallons sounded but little; but the number of days they had for filling the reservoir and on which they would be dependent on their reservoir would increase enormously with every 50 million gallons, or even every 10 million gallons additional storage. It was a sort of compound interest. The reason assigned by Sir A. Binnie was this—that, in consequence of the flow of the sewage of London discharged at Barking Creek, the sewage matter itself was taken up an enormous distance; and unless there was a scour from the fresh water, portions were deposited on the banks, and the health of London might be affected. Having read an extract from Sir A. Binnie's evidence, he said he wished to ask (and he hoped that Directors and shareholders

GAS AND WATER COMPANIES STOCK AND SHARE LIST.

Referred to on p. 1468.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	Apl. 15	10½	Alliance & Dublin 10 p. c.	23½–24½	..	4 5 9
100,000	10	,,	7½	Do. 7 p. c.	16–17	..	4 8 3
300,000	100	Jan. 3	5	Australian 5 p. c. Db.	107–109	..	4 11 9
200,000	5	May 26	6	Bombay, Ltd. . . .	5⅞–6¼	+¼	4 16 0
40,000	5	,,	6	Do. New, £4 paid .	4½–5	..	4 16 0
880,000	Stk.	Feb. 24	12	Brentford Consolidated	290–295	..	4 1 4
240,000	,,	,,	9	Do. New . . .	215–220	..	4 1 10
50,000	,,	,,	5	Do. 5 p. c. Prf.. .	140–145	..	3 9 0
159,375	,,	June 10	4	Do. 4 p. c. Db. Stk.	130–135*	..	2 19 3
220,000	Stk.	Mar. 30	11½	Brighton & Hove Orig..	270–275	..	4 3 8
218,820	,,	,,	8½	Do. A. Ord. Stk. .	195–200	..	4 5 0
933,500	Stk.	Feb. 24	5	Bristol, 5 p. c. max.. .	127–132	..	3 15 9
420,000	20	Ma . 30	11½	British	54–56	–½	4 0 4
50,000	10	Mar. 11	11½	Bromley, Ord. 10 p. c. .	25–27	..	4 5 2
75,000	10	,,	8½	Do. 7 p. c. .	20–22	..	3 17 3
500,000	10	Apl. 29	6	Buenos Ayres (New) Ltd	9–9½	..	6 6 4
98,122	Stk.	Dec. 30	4	Do. 4 p. c. Db. Stk.	99–101	+1	3 19 3
150,000	20	Mar. 11	8¼	Cagliari, Ltd. . . .	30½–31½	..	5 4 9
100,000	10	June 10	7	Cape Town & Dis., Ltd.	15–16*	..	4 7 6
50,000	50	May 3	6	Do. 6 p. c. 1st Mort.	58–60	..	5 0 0
550,000	Stk.	Apl 15	13¾	Commercial Old Stock .	320–325	–2	4 3 1
200,750	,,	,,	10½	Do. New do. . .	250–255	..	4 2 4
200,750	,,	June 10	4½	Do. 4½ p. c. Db. do.	148–153*	..	2 18 10
800,000	Stk.	June 10	12	Continental Union, Ltd.	207–212*	–3	5 13 2
200,000	,,	,,	9	Do. 7 p. c. Prf. .	195–200*	..	4 10 0
51,600	Stk	Feb. 24	14	Croydon A 10 p. c. . .	310–315	..	4 8 11
168,400	,,	,,	11	Do. B 7 p. c. . .	255–265	..	4 3 0
595,000	Stk.	Feb. 24	5½	Crystal Palace Ord. 5 p. c.	125–130	..	4 0 9
60,000	,,	,,	5	Do. 5 p. c. Prf. .	142–145	..	3 9 0
486,090	10	Jan. 27	11	European, Ltd. . . .	23½–24½	..	4 9 9
354,060	10	,,	11	Do. £7 10s. paid .	17–18	..	4 11 9
5,922,110	Stk.	Feb. 10	12½	Gaslight & Coke, A, Ord.	293–298	–5	4 5 6
100,000	,,	,,	4	Do. B, 4 p. c. max. .	118–123	..	3 5 1
665,000	,,	,,	10	Do. C, D, E, 10 p. c. Prf.	302–307	..	3 5 2
30,000	,,	,,	5	Do. F, 5 p. c. Prf. .	150–155	..	3 4 6
60,000	,,	,,	7½	Do. G, 7½ p. c. do. .	220–225	..	3 6 8
1,300,000	,,	,,	7	Do. H, 7 p. c. max. .	195–200	..	3 10 0
463,000	,,	,,	10	Do. J, 10 p. c. Prf. .	300–305	..	3 5 7
476,000	,,	,,	6	Do. K, 6 p. c. Prf. .	182–187	..	3 4 2
1,061,150	,,	June 10	4	Do. 4 p. c. Db. Stk. .	130–133*	..	3 0 2
294,850	,,	,,	4½	Do. 4½ p. c. do. .	148–153*	..	2 18 10
958,000	,,	,,	6	Do. 6 p. c. do. .	198–203*	..	2 19 1
70,000	10	May 12	8	Hongkong & China, Ltd.	13½–14½	..	5 10 4
3,800,000	Stk.	,,	10	Imperial Continental .	207–212	–3	4 14 4
376,400	100	Feb. 1	4	Do. 4 p. c. Dbs. Red.	98–101	..	3 19 3
473,600	Stk.	Feb. 10	3½	Do. 3½ p. c. Db. Stk. ,,	103–106	..	3 6 0
540,000	100	Apl. 1	5	Met. of Mel- 5 p. c. Db.	110–112	..	4 9 3
250,000	100	,,	4½	bourne 4½ p. c. Db.	107–109	..	4 2 7
					* Ex div.		

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
75,000	5	Dec. 15	6	Malta & Medn., Ltd. .	5¼–5⅝	..	5 4 4
541,920	20	June 10	5	Monte Video, Ltd. . .	14–15*	..	6 13 4
617,946	Stk.	Feb. 24	9¾	Newc'tle & Gatesh'd Con.	235–240	..	4 1 8
252,355	Stk.	Jan. 3	3½	Do. 3½ p. c. Db. Stk.	115–120	..	2 18 4
150,000	5	May 26	8	Oriental, Ltd. . . .	7½–8	..	5 0 0
135,000	5	,,	8	Do. New, £4 10s. pd.	6½–7	..	5 2 11
15,000	5	,,	8	Do. do. 1879, £1 pd.	1¼–1⅜	..	4 11 5
60,000	5	Mar. 11	7	Ottoman, Ltd. . . .	4½–5½	..	6 13 4
500,000	100	June 1	6	People's Gas 2nd M. of Chicago Bd. .	103–108	..	5 11 1
848,070	10	May 26	6	River Plate Ord.. . .	9–9½	..	6 6 4
250,000	Stk.	Jan. 27	4	Do. 4 p. c. Db. Stk.	98–100	..	4 0 0
250,000	10	Apl. 29	10	San Paulo, Ltd. . . .	15–16	..	6 5 0
135,000	Stk.	Mar. 30	10	Sheffield A.	242–248	..	4 0 8
209,053	,,	,,	10	Do. B.	245–248	..	4 0 8
447,427	,,	,,	10	Do. C.	245–248	..	4 0 8
5,531,250	Stk.	Feb. 24	5¼	South Metrop., 4 p. c. Ord.	138–143	+2	3 13 5
1,460,000	,,	Jan. 13	3	Do. 3 p. c. Db. Stk. .	101–104	..	2 17 8
60,000	Stk.	Mar. 11	12	Tottenham and A. .	285–295	..	4 1 4
60,000	,,	,,	9	Edmonton B. ,	205–215	..	4 3 9
182,380	10	June 10	7	Tuscan, Ltd.	13–14*	..	5 0 0
149,900	10	Jan. 3	5	Do. 5 p. c. Dbs. Red..	100–103	..	4 17 1
				WATER COMPANIES.			
746,164	Stk.	Dec. 30	10½	Chelsea, Ord.	320–325	..	3 4 7
150,000	,,	,,	5	Do. 5 p. c. Prf. . . .	172–177	..	2 16 6
160,000	,,	,,	4½	Do. 4½ p. c. Pf. Stk., 1875	150–155	..	2 18 1
175,785	,,	Mar. 30	4½	Do. 4½ p. c. Db. Stk. .	157–162	..	3 15 7
1,720,560	Stk.	Apl. 15	8	East London, Ord. . .	225–230	..	3 9 7
654,740	,,	Dec. 30	4½	Do. 4½ p. c. Db. Stk.	158–162	..	2 15 7
390,000	,,	,,	3	Do. 3 p. c. Db. Stk..	104–106	..	2 16 7
700,000	50	Dec. 15	7½	G'd Junct'n, 10 p. c. max.	117–120	+1	3 2 6
310,000	Stk.	Mar. 30	4	Do. 4 p. c. Db. Stk.	140–145	..	2 15 2
708,000	Stk.	Feb. 10	13	Kent	358–363	..	3 11 8
160,000	,,	,,	7	Do. New, 7 p. c. max..	213–218	..	3 4 3
1,043,800	100	Dec. 30	10	Lambeth, 10 p. c. max..	297–302	+2	3 6 3
406,200	100	,,	7½	Do. 7½ p. c. max..	228–233	..	3 4 4
350,000	Stk.	Mar. 30	4	Do. 4 p. c. Db. Stk.	140–145	..	2 15 2
500,000	100	Feb. 10	13	New River, New Shares	432–437	..	2 19 6
1,000,000	Stk.	Jan. 27	4	Do. 4 p. c. Db. Stk.	141–146	..	2 14 10
902,300	Stk.	Dec. 15	6	Southw'k & V'xhall, Ord.	162–166	+1½	3 12 3
126,500	100	,,	6	Do. do. 7½ p. c. max..	152–157	..	3 16 5
489,200	Stk.	,,	5	Do. do. 5 p. c. Prf. .	170–175	..	2 17 2
1,019,585	,,	Apl. 15	4	Do. 4 p. c. A Db. Stk.	140–143	..	2 15 11
1,155,066	Stk.	June 10	10	West Middlesex . . .	295–300*	..	3 6 8
200,000	,,	,,	4½	Do. 4½ p. c. Db. Stk.	160–163*	..	2 15 3
200,000	,,	Mar. 11	3	Do. 3 p. c. Db. Stk.	104–106	..	2 16 7
					* Ex div.		

of Water Companies would ask) this question, and have a satisfactory answer to it: "Are the shareholders of the Water Companies to be indirectly taxed to lessen the expenditure that is to be incurred by the London County Council in properly carrying out its duties?" Although the County Council were requiring the Companies to prepare for a population of 12 millions or 13 millions by 1931 or 1937, he had not heard that they were themselves preparing any great measure for carrying off all the extra water; but they could not bring water into London without its having to be carried off. If it was necessary that great works should be undertaken by the Water Companies, it was also necessary that great works should be undertaken by the County Council; and it was a most unreasonable thing to fetter the Companies, and put them to enormous additional expense, to save other authorities from bearing their proper expenditure. A tremendous responsibility attached to the County Council—quite as heavy as that which attached to the Water Companies; and if the Companies were willing to face their responsibilities, other authorities ought also to be willing to face theirs, without seeking to put an undue share of the burden on the Companies. He concluded by moving the adoption of the report and accounts.

The Right Hon. Viscount KNUTSFORD, G.C.M.G., seconded the motion; and it was carried unanimously.

The CHAIRMAN then proposed the payment of a dividend for the last financial half year at the rate of 7½ per cent. per annum on the £50 "A" shares, the £25 "B" shares, and the £25 "C" shares, and of 7 per cent. per annum on the £50 "D" shares.

Mr. H. MOTT seconded the motion, which was carried unanimously.

Resolutions were afterwards passed re-electing the retiring Directors (Messrs. C. Horsley, F. Tagart, F. Tendron, and Noel Whiting) and the retiring Auditor (Mr. R. A. M'Lean).

The CHAIRMAN afterwards proposed a resolution authorizing the Directors "to expend in each half year a sum not exceeding £105 in donations to such charitable institutions having special claims on the Company as the Directors consider fit."

The Hon. S. HOLLAND seconded the motion; and it was carried unanimously.

On the motion of Dr. LEESON, seconded by Mr. W. WRIGHT, a vote of thanks was accorded to the Chairman, Directors, and staff; and the proceedings closed.

The Birmingham Gas Department and Superannuation.—On the motion of Alderman Pollack, the Birmingham City Council last Tuesday approved of an amending scheme of superannuation, by which existing contributors to the Gas Department (Salaried Officers) Superannuation Fund and the Gas Department (Meter Inspectors) Superannuation Fund would be enabled to withdraw from these funds, and receive instead the benefits of the Corporation Superannuation Scheme of 1897. Alderman Pollack explained that the Committee considered it only reasonable that their employees should be placed in the same position as other Corporation servants; while to the department and the Council generally it would be an advantage to have only one superannuation scheme instead of four.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

In Peebles, the process of negotiation by circular or manifesto still goes on. There have been three this week—one by Mr. W. Young, on Wednesday, which was replied to by Treasurer Williamson on Thursday; and to-day the Town Clerk has issued a further circular to the proprietors of stock of the Peebles Gaslight Company, designated as "(now dissolved)." In Mr. Young's circular, he very conclusively shows that the dissolution of the Company cannot benefit the Corporation, because the liquidator who would be appointed would be bound to endeavour to get the best price he could for the undertaking; and the shareholders could run the price up as against the Corporation. Of course, that is so; and the conclusion is thus brought home to anyone who has studied the subject that the Corporation's policy is an over-reaching one. Mr. Williamson's circular is remarkable for an extraordinary table of figures, intended to expose Mr. Young's proposal that the Corporation should acquire the undertaking on the footing that they pay ten per cent. annuities. Mr. Williamson imagines that the reduction in the price of gas by 5d. per 1000 cubic feet last year will cost the Company, in loss of revenue, £250. Of course, this is a fallacy; and the sum may be struck out. He then estimates the amount necessary to meet depreciations and renewals, calculated at 5d. per 1000 cubic feet, at £250. This may also be struck out, because the reserve fund of £3000 which the Company possess is sufficient to meet renewals for many years; and as to depreciation, the works in Peebles have never been allowed to depreciate, but have, by careful management, been kept in first-class condition. Mr. Williamson enters annuities at £580. Last week, I showed that they would be only £560. Then he calculates that a statutory sinking fund at 2½ per cent. would amount to £464; and, adding all these together, he makes out that the annual charges upon the undertaking would be £1544, and that, as the profit had been given by Mr. Young at £1206, there would be a deficit of £338. This amount of £464 must be dismissed also. The statutory sum of 2½ per cent. is provided, not for redemption of annuities, but for redemption of borrowed money; and as the Corporation would borrow no money, there would be no need to provide for its repayment. Suppose they accumulated money at the rate of 2½ per cent. per annum upon the capitalized value of the annuities, to whom would they pay it? Not being in debt, there would be nobody to receive it. The redemption of annuities is a different matter. Under the statutes which they would administer—the Burghs Gas Supply Acts—no sum is fixed to be set aside for the redemption of annuities. Buf I have before me a Special Act of Parliament, which deals with the redemption of gas annuities; and the rate directed in this instance to be set apart for the purpose is 15s. per cent. per annum. At the very highest, this would only require £130 a year in Peebles; and therefore the total charges upon the revenue would be £560 and £130—together £690. If the revenue be estimated at £1000, there would thus be left an annual balance of about £310, out of which the Corporation could, by agreement, redeem annuities as they found opportunity. The last circular—that by the Town Clerk—is an intimation

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BLACKBURN	1,250,000	TORONTO (2nd Cont.; Remodelled)	2,000,000
WINDSOR STREET WORKS, BIRMINGHAM	2,000,000	LINDSAY (Remodelled)	125,000
SALTLEY WORKS, BIRMINGHAM	2,000,000	MONTREAL	500,000
COLCHESTER	300,000	BELLEVILLE	250,000
BIRKENHEAD	2,250,000	OTTAWA (Second Contract)	250,000
SWINDON (New Swindon Gas Co.)	120,000	BRANTFORD (Remodelled)	200,000
SALTLEY WORKS, BIRMINGHAM (Second Contract)	2,000,000	ST. CATHERINES (Remodelled)	250,000
WINDSOR STREET WORKS, BIRMINGHAM (Second Contract)	2,000,000	KINGSTON, PA.	125,000
HALIFAX	1,000,000	PETERBOROUGH, ONT.	250,000
TORONTO	250,000	WILKESBARRE, PA.	750,000
OTTAWA	250,000	ST. CATHERINES (Second Contract)	250,000
YORK	750,000 Cubic Feet.	BUFFALO, N.Y.	2,000,000
		WINNIPEG, MAN.	500,000
		COLCHESTER (Second Contract)	300,000

that the time within which the offer of the Town Council fell to be accepted expired yesterday; but he was directed to say that the time had been extended until 3 o'clock in the afternoon of Thursday next, the 23rd of June, and that this was done because of the serious interests involved, and of communications which had been received from several individual proprietors of stock, who had been considering for themselves the burgh's offer. It is not said that any have decided to accept the offer, though the wording would almost make this to be assumed, at first reading. It is, doubtless, however, with a view to securing some wavering ones that the postponement of the time is made. It may be a coincidence, or it may not, but the first statutory meeting of the Peebles Gaslight Company, Limited, is fixed for Thursday, the 23rd inst. Next week we ought to see some developments in this business. Parties should, at least, begin to measure their strength with each other; and, pity it is, but that measurement is likely to be first of all in the Law Courts.

Treasurer Ritchie submitted the annual accounts of the Dundee Gas Department at a statutory meeting of the Town Council on Wednesday. They had, he said, received £1214 more for gas than in the preceding year—a circumstance which was peculiarly gratifying, as it indicated a still growing consumption. On the other hand, chemical products showed a decrease of nearly £900. Of the expenditure, no less a sum than £565 had been incurred additional, in assessments, chiefly through the action of the Burgh Assessor in disallowing certain repairs formerly charged to capital, and in reducing interest. The quantity of gas sold was 5¼ million cubic feet more than estimated for; and when they remembered that they had an increase of 16 million cubic feet in the preceding year, and also took into account the mildness of the season, the increase was not unsatisfactory. There was a deficit on the year's working of £314; but, strictly speaking, it was not a deficit, as they were paying £1500 to the contingent fund out of revenue. The true state of the case was that they had a surplus of nearly £1200. The contingent fund now amounted to £6000. He proposed that they should, next year, out of the revenue from electricity, set apart a sum of £1000 to found a contingent fund in that department also. It was peculiarly gratifying that prepayment meters had proved very popular. For the current year, they estimated a revenue of £84,878, and an expenditure of £84,863, which would leave a surplus of £14 18s. They would only contribute £500 to the contingent fund; but then, during the past year, £800 had been spent upon the renewal of chimneys, which might have been charged to this fund. Another reason for the diminished contributions to the contingent fund was their unwillingness to raise the price of gas. The accounts were adopted; and the price of gas was continued at the same rates. The Gas Department seems to be flourishing, notwithstanding that there have been dull times in Dundee.

In presenting the accounts of the Perth Gas Commissioners, to the annual meeting on Monday, ex-Bailie Cuthbert, the Convener of the Works Committee, said that the Commissioners were to be congratulated on the very satisfactory state of their affairs. They estimated to sell 131 million cubic feet of gas during the current year, which would be 5 million cubic feet more than last year. They would be able to sell gas at the same price as last year—namely 3s. 2d. per 1000 cubic feet—and have a small surplus over. The Commissioners, he thought, must be gratified that they were able to do this, in the face of assessments rising all round them; and the thanks of the Commissioners should be given to all the officials for their energy and ability during the past year. The accounts were adopted.

The Hawick Gas Company made a profit of £1931 last year. It is proposed to pay a dividend at the rate of 10 per cent., and to retain the price of gas at 3s. 4d. per 1000 cubic feet. The shareholders of the Milngavie Gas Company held their annual meeting this week. It was reported that the consumption of gas amounted to 11 million cubic feet, and that the profit was £397. A dividend at the rate of 5 per cent. was declared.

The effect of the advice given by "Ironmaster" regarding the proposed acquisition by the Corporation of the undertaking of the Saltcoats Gas Company, has not been long in being manifested. It has been so effective that, on Tuesday night, when Provost Smith moved that a vote of the ratepayers be taken to ascertain their views on the subject, it did not find favour, notwithstanding his advocacy of the advantages to be derived by the community in the ownership of the gas-works; and the subject was dropped.

A meeting of the Monifieth Police Commission was held on Monday night, to receive the deputation from the open air meeting referred to last week, at which a protest against the erection of a gas-works was carried. The protesters having been heard, Provost Stewart gave them his opinion of their conduct very firmly. The same gentlemen, he said, cried out, when the Commissioners proposed to adopt the statute, that the gas supply should be in the hands of a private company; and now, when a Company had been formed, they opposed it. The Provost also justified the action of the Company in the selection of the site, which, he said, was at present in an unsightly condition, and would be improved by the erection of a gas-works upon it. The protest was not heeded, at which some of the deputation, before they withdrew, loudly complained.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 18.

Sulphate of Ammonia.—The business of the week has resulted in a further decline in values; the closing quotations being £9 per ton f.o.b. Hull and Leith, and £9 3s. 9d. per ton f.o.b. Liverpool. Prices have been somewhat irregular; and sales have been reported at under current quotations. But within the past day or two there has been evidence of greater anxiety on the part of buyers to cover their sales for June delivery; and the market closes with a firmer feeling all round. Consumers for the most part continue to hold themselves aloof. There is nothing reported in the forward position; and quotations are nominal.

Nitrate of Soda is firm in all positions; and 7s. 9d. per cent. is the value of fine quality on spot.

LONDON, *June* 18.

Tar Products.—Business is quiet in all directions. Benzols are flat, and falling in value. The slight improvement noted in pitch is barely maintained; while other products are neglected, with inclination to

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weaker prices. The advent of still larger quantities of products from coke-ovens is probably accountable for the unfortunate position in which most products stand; but this being a quiet season, with production at its lowest, doubtless has something to do with the matter. Tenders for tar contracts show a very marked variation in the ideas of distillers, as to the prospects of tar products. There is no doubt, however, that two important contracts recently let are certain to leave the buyers a loss; while, on the other hand, undue depression in values is undoubtedly taking place in other quarters.

The business of the week may be marked as follows: Tar, 10s. to 14s.; pitch, 21s. to 22s. 6d east coast; 18s. to. 19s. west coast. Benzols, 90's, 10d.; 50's, 11d. Toluol, 1s. 2d. Solvent naphtha, 1s. 2d. Heavy naphtha, 1s. 1½d. Crude, 30 per cent., naphtha, 4½d. Creosote, 2½d. Heavy oils, 45s. to 50s. Carbolic acid, 60's, 2s.; crystals, 7½d. Naphthalene, 50s.; salts, 30s. Anthracene, "A," 4½d. to 5d.; "B," 3d. to 4d.

Sulphate of Ammonia.—This market is showing a little more life after an unaccountable drowsiness; and to-day there are more inquiries from legitimate buyers, both for prompt and for forward delivery, particularly for the latter. Makers are firm in their ideas of value; but so far buyers do not improve on former quotations, and the article may be taken to be worth £9, less 3½ per cent. at all ports.

COAL TRADE REPORTS.

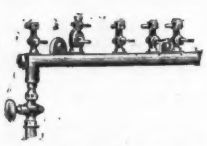
From Our Own Correspondents.

Lancashire Coal Trade.—Uncertainty as to what may be the possible development of the present situation in the coal trade, is apparently retarding the settlement of the usual contracts. The prolongation of the South Wales dispute tends, of course, to strengthen the position of colliery proprietors in this and other districts; and the probability that the Miners' Federation will in any event—even if the matter is allowed to stand in abeyance for the present—force on the wages question before the end of the year, necessarily induces extra caution on the part of coal-owners with regard to anything like long forward contracts. The unmistakable indications afforded, however, by the South Wales dispute that, with even so large an output withdrawn from the market, the production is ample for all requirements, does not encourage over-confidence that any very material advance in prices can be established generally; and while colliery owners hesitate to commit themselves to new engagements for the ensuing twelve months, except at substantially better prices than those obtained last year, buyers are not at all eager about placing contracts where any considerable advance is held for, as they are anticipating that when the Welsh dispute is ended it cannot fail to have a weakening effect upon prices. The result is that so far comparatively only a small weight of gas coal has been settled; while the railway fuel contracts, which are usually closed before the end of May, are still pending; but the belief in well-informed quarters is that these will be settled in the first week of July. So far as the gas coal contracts already placed are concerned, colliery proprietors would seem in most cases to have secured advances of about 6d. per ton over last year, though in some instances not more than 3d. per ton more, and in others the same figures as last year, have been accepted. With regard to the locomotive fuel contracts, the leading colliery owners are still confident that they will get the advance of 9d. per ton over last year that they have been holding for. In the general run of trade, steam and forge coal and engine classes of fuel are in active request, and fully maintain late rates, with also advances on contracts demanded. For shipment, there has been a large weight of business put through during the past week; and prices are firm. Current quotations at the pit mouth are 10s. to 10s. 6d. per ton for best Wigan Arley; 8s. 6d. to 9s., for Pemberton four-feet and seconds Arley; 7s. to 7s. 6d., for common house coal; 6s. 6d. to 7s., for steam and forge coal; 4s. 6d. to 4s. 9d., for best slack; 3s. 9d. to 4s. 3d., for medium; and 3s. 3d. to 3s. 6d., for common sorts. Steam coal for shipment ranges from 8s. 3d. and 8s. 6d. per ton for ordinary qualities, to 8s. 9d. and 9s. 3d. for the better descriptions, delivered at the Garston Docks or the High Level, Liverpool.

Northern Coal Trade.—There has been an increased demand for coal, in preparation for the lessened output which the local holidays of the next few days usually gives; and prices for early delivery are firmer in consequence. Best Northumbrian steam coals are quoted at from 13s. to 13s. 6d. per ton f.o.b.; second-class steam at 12s. 6d.; and steam smalls, at 4s. 9d. to 5s. Gas coals have been steady; the consumption being above that usual at this time of the year. For contracts forward, the price has varied from 8s. to 8s. 6d. per ton f.o.b.; while sales of odd cargoes have been at prices not materially varied from this. Most of the large contracts previously referred to have now been, or are about being, settled, and, generally speaking, at a considerable increase on the quotations under the old contracts. There is now under these a settlement substantially of the prices that will rule for gas coals for some time ahead. Other classes of coals display little or no change. Gas coke shows only the alteration of rather heavier shipments.

Scotch Coal Trade.—The demand for Scotch coal has improved, since it has become apparent that the dispute in Wales is not likely to be settled so soon as was expected. The season of the year has also come when the miners take very free holidays. Both these influences have tended to lessen the volume of coal on sale at home, and consequently to somewhat advance prices. The quotations are: Main, 8s. per ton f.o.b. Glasgow; ell, 8s. 9d. to 9s.; and splint, 8s. 6d. to 8s. 9d. The shipments for the week were 201,359 tons—a decrease upon the preceding week of 18,458 tons, but an increase upon the corresponding week of last year of 43,088 tons. For the year to date, the total shipments have been 3,824,298 tons—an increase over the corresponding period of the past year of 582,461 tons.

Shrewsbury Water Question.—The Shrewsbury Town Council came to the conclusion, at their meeting yesterday week, that, before committing themselves to further expenditure in connection with the water question, it would be prudent, in view of the rejection of the Severn scheme by the Local Government Board, to have an interview with that body, and ask for their advice. Five members were appointed to form the deputation.



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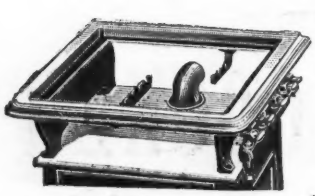

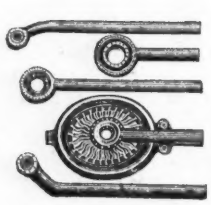

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Messrs. Richmond and Co.'s supplement to the "JOURNAL" to-day gives particulars of a novel and interesting competition—"Picture Puzzles."

Messrs. Kirkham, Hulett, and Chandler, Limited, have obtained an order for a patent "Standard" washer-scrubber and a Marshall patent battery condenser for erection at the Pinner Gas-Works.

Messrs. W. & B. Cowan, Limited, of Edinburgh, have secured the contract for the supply and erection of two 20-inch governors for the Darwen Corporation Gas-Works. One is to be controlled by Mr. William Cowan's patent electrical pressure system, worked by means of cells.

Messrs. Jonas Drake and Son, of Halifax, have obtained a contract for the construction of regenerator furnaces, &c., on their patent tube principle, at the Goole Gas-Works, and also for the annular condensers from drawings prepared by the Engineer to the Council, Mr. Dunn.

The Broughty Ferry Police Commission have accepted the offer of the Barrowfield Iron-Works, Limited, to provide the ironwork in connection with the extension of the Corporation Gas-Works, at the price of £1500. The work is expected to be completed in time for the winter season.

The exceedingly tastefully printed catalogue of domestic labour-saving appliances which Messrs. Fletcher, Russell, and Co., Limited, have just issued under No. 210, is at once a convincing proof of the activity of the firm in the production of articles facilitating the use of gaseous fuel in the household, and a striking example of tasteful arrangement of illustrations which do not usually come under the denomination of high art.

The Gas Committee of the Selby District Council have just placed the following contracts: For a gasholder 98 feet diameter and 25 feet deep, in steel tank, 102 feet diameter and 25 ft. 6 in. deep, with Messrs. Clayton, Son, and Co., Limited, of Leeds; for a purifier-house 90 feet by 32 feet, a meter-house 30 feet by 16 feet, and drainage and boundary wall, with Messrs. Jackson Bros., of Goole; and for four purifiers, 16 feet square, with wrought-iron covers and lifting gear, with Messrs. Newton, Chambers, and Co., of Sheffield.

Exhibitions of Gas Appliances have lately been held by the following firms: The Davis Gas-Stove Company, Limited, at Swansea, with lectures by Miss Amy Wilkinson. Messrs. Fletcher, Russell, and Co., at Bexley, with lectures by Mrs. Collins. Messrs. W. Parkinson and Co., at Harpurhey (Manchester), with lectures by Madame Alting-Mees; at Handsworth, with lectures by Miss E. A. Smith; and at Walsall (in conjunction with Messrs. John Wright and Co.), with lectures by Miss Sanderson. Messrs. Richmond and Co., Limited, at the Royal Agricultural Show, Birmingham; also at Norton Thorpe, Stockbridge (Edinburgh), Hulme (Manchester), Annan, and Aberystwyth, with lectures by Miss Turner, Miss Richmond, Miss Smallwood, Mrs. Middleton, and Miss Dennell. Messrs. John Wright and Co., Limited, at Stockport, with lectures by Miss Barber; and at Darwen, with lectures by Mrs. Gillingham Page. Messrs. R. and A. Main, in the Town Hall, Leven, Fife, with cookery demonstrations by Miss Dods, of the Edinburgh Training School of Cookery and Housekeeping.

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Chemical Works, Leeds, specially produce this ACID from SULPHUR, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

PORTER & CO., Gowts Bridge Works,
LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER LINCOLN."
[For Illustrated Advertisement, see p. 1501.]

TO GAS AND WATER OFFICIALS.

SPECIALLY favourable terms for Cycles.
First-Class Workmanship and Material guaranteed. Art Catalogue post free.
MELROSE CYCLE COMPANY, COVENTRY.

WATER-GAS PLANT.

ENGINEERS contemplating the above are invited to communicate with the Advertiser, who is prepared to give every assistance in designing Plant of any capacity.
J. L. FEATHERSTONE, 30, Amesbury Avenue, STREATHAM HILL.

GAS TAR wanted.
BROTHERTON AND CO., Tar Distillers.
Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SPECIAL PAINT FOR GAS-WORKS.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.
Telegrams: "ENAMEL." National Telephone 1769.

GAS PURIFICATION.

OXIDE OF IRON BOG ORE.

BALE & CO.'S Oxide of uniform quality.
SPECIAL FIRE CEMENT, OXIDE PAINTS, OILS, SULPHURIC ACID, &c.
120 and 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."

SULPHURIC ACID for Sale.
BROTHERTON AND CO., Chemical Manufacturers.
Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SULPHATE OF AMMONIA SATURATORS.

JOSEPH TAYLOR & CO., Chemical
Plumbers, &c., and Makers of every description of Solid Plate Lead and Timber Cased Saturators, &c., CENTRAL PLUMBING WORKS, TOWN HALL SQUARE, BOLTON. Special attention to Repairs.
Before placing Orders, please write for Estimate.
Telegraphic Address: "SATURATORS, BOLTON."

SADLER & CO., Ld., Middlesbrough;
ULVERSTON (BARROW); PORTSMOUTH; CARLTON (N.E.R.); and STOCKTON. Tar and Petroleum Distillers. Benzol and Petroleum Spirit, 700 and other Gravities specially prepared for Carburetting. SOLAR OIL for Gas Making, Kerosene, &c.
Correspondence invited.
Telegraphic Address: "SADLER, MIDDLESBROUGH."

IMPORTANT.

OLD Retorts made equal to new by repairing them with CROWTHER'S PATENT STICKFAST FIRE CEMENT. Unequalled for Repairing Inclines. Can be used in Hot or Cold Retorts; and "A1." for Mouthpiece Joints. Satisfaction Guaranteed.
CROWTHER, Practical Retort Setter, Manor Street, HUDDERSFIELD.

ENRICH YOUR GAS
WITH
CHEAP BENZOL.

AT to-day's Price of Benzol, Illuminating POWER cost less than a HALFPENNY PER CANDLE.
Apply to SADLER AND CO., MIDDLESBROUGH.

GWYNNE & BEALE'S
PATENT
GAS-EXHAUSTERS AND STEAM-ENGINES

FOR FULL PARTICULARS, APPLY TO THE MAKERS:

GWYNNE & CO.,

Telegrams:
"GWYNNEGRAM, LONDON."

HYDRAULIC AND GAS ENGINEERS

Telephone
No. 95 Holborn.

(Late Essex Street Works, Victoria Embankment, London),

BROOKE STREET WORKS, HOLBORN, LONDON, E.C.

SPENT OXIDE wanted.
BROTHERTON AND Co., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

CANNEL, COAL, ETC.

JOHN ROMANS & SON, EDINBURGH,
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, / NEWTON GRANGE, NEWBATTLE, DALKEITH, } SCOTLAND.

HYDRATED OXIDE OF IRON.

PREPARED from pure Iron.
Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.
READ HOLLIDAY AND SONS, LIMITED, HUDDERSFIELD.

GAS PURIFICATION BY HYDRATED OXIDE.

THE CHEAPEST OXIDE ON THE MARKET.

THIS Material is of full strength and exceptional activity, and is giving great satisfaction in those Gas-Works using the same.
Enquiries invited by T. B. JONES & Co., Gas-Works, Dronfield, near SHEFFIELD.

SITUATION wanted by Advertiser, with 5½ Years' Experience, as CLERK in Gas Office or COLLECTOR of ACCOUNTS. Accustomed to Prepayment Meter System. Highest References. Age 23.
Address No. 3079, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

STEADY reliable Man (age 30) seeks Situation as LEADING STOKER, or to TAKE CHARGE OF SMALL GAS-WORKS making about 2 or 2½ millions. Used to Engine and Exhauster, Valves, &c. Sulphate Making. Eight Years' good References.
Address No. 3084, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

£10 for obtaining Advertiser permanent post as MANAGER of Works making 18 to 20 Millions, or COLLECTOR for larger Gas Company. Five Years' experience. Good Accountant. Excellent References. Age 30. Genuine Correspondence only invited. No Agencies.
Address No. 3083, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, at once, good Retort Setters.
Apply to JONAS DRAKE AND SON, Ovenden, HALIFAX.

GAS Stoker Wanted. Permanent Situation.
Apply to the MANAGER, Gas-Works, SOLIHULL.

WORKING Manager Wanted to take charge of Small Works and Plant in Country Place. Small Engine and Boiler. Make 1½ Millions; comfortable job. Good terms to suitable Man.
Apply to Mr. W. TAYLOR, Gas Engineer, Glossop, near MANCHESTER.

SERVICE LAYER.

WANTED, immediately, a steady young Man as OUTDOOR SERVICE LAYER for a Gas Company in South Wales.
Apply, by letter, to No. 3081, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by a well-known Firm of Gas-Meter Manufacturers, a competent and experienced TRAVELLER, with good Connection among London and South of England Gas Departments.
State Age, Experience, References, and Terms, to Box 61, P.O., OLDHAM.

CITY OF LINCOLN.
PUBLIC HEALTH ACT, 1875.

LINCOLN CORPORATION WATER-WORKS.
TO WATER-WORKS ENGINEERS.

THE Corporation of the City of Lincoln invite APPLICATIONS for the appointment of WATER-WORKS ENGINEER.
Candidates must have had previous experience in a similar capacity with a Company or Corporation, supplying Water to a Town or District under Parliamentary Powers, and be competent to superintend the laying of Mains and the management of Engines, Plant, and Machinery, and the general conduct of a Water-Works Undertaking.
The Engineer appointed will be required to devote the whole of his time to the service of the Corporation.
The Salary will be at the rate of £350 per annum.
Applications, stating Age, present Occupation, and giving an account of previous Experience as a Water Engineer, in the Candidate's own Handwriting, together with not more than three recent Testimonials, must be sent to me, endorsed "Water-Works Engineer," on or before the 16th day of July, 1898.
Canvassing for the appointment will disqualify a candidate.
By order,
H. K. HEBB,
Deputy Town Clerk.
Lincoln, June 13, 1898.

BOROUGH OF ROTHERHAM.

THE Corporation require the Services of a CLERK OF WORKS to superintend the work in connection with general Extensions at their Gas-Works, and to act under the supervision of the Gas Engineer.
Salary £2 per week.
Applications, stating Age and previous Experience, with *copies* of three Testimonials, to be sent to the Office of the undersigned not later than Saturday, the 25th inst.
H. H. HICKMOTT,
Town Clerk.
Council Hall, Rotherham,
June 17, 1898.

BOROUGH OF COLNE.
(GAS DEPARTMENT.)

ASSISTANT MANAGER.

THE Gas Committee are prepared to receive APPLICATIONS for the Appointment of an ASSISTANT at their Gas-Works.
Applicants can obtain a copy of the duties they will have to perform from Fred Thorpe, the Engineer and Manager.
Salary, £100 per annum.
Applications, stating Age and Experience, accompanied by not more than three recent Testimonials, to be delivered at the Town Hall, Colne, not later than Friday noon, June 24, 1898, addressed to the Chairman of the Gas Committee, and endorsed "Assistant."
ALFRED VARLEY,
Town Clerk.
Town Hall, Colne,
June 13, 1898.

SHEFFIELD UNITED GASLIGHT COMPANY.

WORKS SUPERINTENDENT.

WANTED, by the Directors of this Company, an experienced and competent Man to act as SUPERINTENDENT at their Effingham Street Gas-Works. (The position is vacant owing to the present Superintendent having been promoted.) He will be required to reside on the Works, with House, Coal, and Gas free.
The Maximum make of Gas at this Station is about 3½ million cubic feet per day.
Applications (marked "Superintendent"), stating Age, previous Engagements, and Salary required, to be made, by letter only, addressed to Sir Fredk. T. Mappin, Bart., M.P., Chairman of the Company, Gas Offices, Sheffield, not later than Friday, July 8, 1898. Testimonials not to be sent till asked for.
HANBURY THOMAS,
General Manager and Secretary.
Commercial Street, Sheffield,
June 15, 1898.

GAS CARBON Wanted, not less than 4-Ton Loads.
Apply to the BRIMINGTON CARBON COMPANY, Sowerby Bridge, YORKS.

WANTED, Carbon in 4 Ton Lots, or more.
State Price, f.o.r. at nearest Station, to No. 3031, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

SULPHATE OF AMMONIA.

WANTED, a small Apparatus of the column make, to produce about 3 tons per week.
Address, with full Particulars, No. 3085, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE—Four Purifiers, 7 feet square, 3 ft. 9 in. deep, with two sets of Grids, Covers, Lifting Gear, twelve 8-inch Valves and Connections, all complete.
Apply to the MANAGER, Gas-Works, ARDROSSAN.

FOR SALE—One 5-Feet internal dia- meter YOUNG'S PATENT GAS-WASHER (Circular), with Six perforated Trays and Water-Tank, complete and in good condition.
Apply to the MANAGER, Gaslight Company, INNERLEITHEN.

FOR SALE (owing to the Electric Light having been installed) a Gentleman's SMALL GAS PLANT. Capacity of Holder 1200 feet, Purifier, Hydraulics, and 100-Light Meter. All complete; a bargain.
Apply to the RELIANCE IRON-WORKS, FARNHAM.

FOR SALE, Cheap—The under- mentioned GAS PLANT:—
2 PURIFIERS, 5 ft. square by 4 ft. deep.
1 PURIFIER, 5 ft. square by 2 ft. 9 in. deep.
CONDENSER, 4 inches diameter, Vertical Pipes.
EXHAUSTER (Gwynne's), 20,000 c. f. per hour.
Apply to SAML. WHILE AND SONS, 60, QUEEN VICTORIA STREET, E.C.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. **Compare Prices and Particulars before ordering elsewhere.**
J. F. BLAKELEY, Gas Engineer, Ravensthorpe, YORKS.

FOR SALE—The complete Gas-Works PLANT of a WOOLLEN MANUFACTORY, capable of supplying 10,000 cubic feet of Gas per diem. Erected within the last Twenty Years.
Particulars from the UPTON LOVELL MANUFACTURING COMPANY, TROWBRIDGE.

THE Directors of the Cranleigh Gas and Coke Company, Limited, invite TENDERS for the supply of about 500 Tons of good screened GAS COAL, delivered at Cranleigh Station (L.B. & S.C. Railway) free, in quantities of about 50 Tons, as ordered, during the Year ending July 31, 1899.
No Forms.
Tenders, addressed to the Secretary, to be sent in on or before Monday, June 27, 1898, sealed and endorsed "Coal."
The Directors do not bind themselves to accept the lowest or any Tender.
H. J. HAYMAN,
Secretary.

CORPORATION OF LEICESTER.

LOCOMOTIVE ENGINE.

THE Gas and Electric Lighting Com- mittee of the above Corporation are requiring a LOCOMOTIVE ENGINE for their Aylestone Road Works.
For Particulars, apply to
ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.
Offices: Millstone Lane,
Leicester, June 15, 1898.

TO COAL CONTRACTORS AND OTHERS.

THE Sedgley Urban District Council invite TENDERS for supplying 500 to 1000 Tons of GAS COAL, the deliveries to be made at the Shut End Siding at such times and in such quantities as may be directed.
Sealed Tenders, marked "Coal," must reach me on or before the 6th of July next.
The Council do not bind themselves to accept the lowest or any Tender.
By order,
JOSEPH SMITH,
Clerk to the Council.
Offices: High Holborn,
Sedgley, June 11, 1898.

BOROUGH OF EVESHAM,
(GAS DEPARTMENT.)

TENDERS FOR GAS COAL.

THE Corporation invite Tenders for the supply of from 1000 to 2000 Tons of best screened GAS COAL, during the Year ending the 30th of June, 1899, to be delivered on Rail at Evesham.
Tenders to be sent in to me not later than the 30th of June inst., to include full Description and Particulars as to Coal and Price. No Forms of Tender supplied.
The Corporation do not bind themselves to accept the lowest or any Tender.
THOS. COX,
Town Clerk.
Town Clerk's Office, Evesham,
June 8, 1898.

GUILDFORD GASLIGHT AND COKE COMPANY

MECHANICAL WASHER-SCRUBBER.

THE Directors of the above Company invite separate TENDERS for the Supply, Delivery, and Erection on their Works of a MECHANICAL WASHER-SCRUBBER, guaranteed to be capable of dealing with 1,000,000 cubic feet of foul Gas per 24 hours, or for similar Washer-Scrubber for 1,500,000 cubic feet.
Tenders to include HORIZONTAL ENGINE, 18-inch INLET and OUTLET and BYE-PASS VALVES and CONNECTIONS.
All to be fixed complete on Foundations provided by the Company to Contractor's Drawings.
Any further Particulars can be obtained on application to the Manager at the Works.
Tenders, endorsed "Tender for Washer-Scrubber," to be sent to David Williamson, Esq., J.P., Chairman of the Gas Company, on or before July 8, 1898.
By order,
WILLIAM TITLEY,
Secretary.
Gas Offices, Guildford,
June 18, 1898.

GLOUCESTER GASLIGHT COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of about 25,000 Tons of GAS COAL for One Year from the 1st day of July next, in such monthly quantities as may be required by the Company.
Tenders to state the price delivered at the Midland Railway Wharf, High Orchard, or the Great Western Railway Wharf, Llanthony, Gloucester; or if sent (as preferred) by Water, the price f.o.b., and also the price delivered at the Gas Company's Wharf on the Gloucester and Berkeley Canal.
Further Particulars and Forms of Tender may be obtained of the Company's Engineer, Mr. R. Morland.
Sealed Tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, to be addressed to the Chairman, Gas Offices, Eastgate Street, Gloucester, and delivered not later than the 1st day of July next.
The Directors reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any Tender.
By order,
WILLIAM E. VINSON,
Secretary.
Gas Offices, Gloucester,
June 2, 1898.

EAST RETFORD CORPORATION.

THE Gas Committee are open to receive TENDERS for the purchase of their surplus TAR and AMMONIACAL LIQUOR for One Year ending June 30, 1899.

Further Particulars may be obtained on application to the undersigned.

J. B. FENWICK,
Engineer and Manager.

June 17, 1898.

EAST RETFORD CORPORATION.

THE Gas Committee of the above Cor- poration are open to receive TENDERS for the supply of 4000 Tons of best GAS COAL or NUTS during the Year ending June 30, 1899.

Tenders to be sent in to the undersigned, endorsed "Tender for Gas Coal," on or before July 1, 1898.

Forms of Tender not supplied.

J. B. FENWICK,
Engineer and Manager.

June 17, 1898.

CIRENCESTER GAS COMPANY, LIMITED.

TENDERS FOR GAS COAL.

THE Directors are prepared to receive TENDERS for the Supply of 3000 Tons, or any less quantity, of GAS COAL, to be delivered free to the Watermoor Station of the Mid and South-Western Junction Railway Company, during the Twelve Months ending the 30th of June, 1899.

Tenders to be sent in not later than Friday, the 1st day of July.

Forms of Tender can be obtained from

JOHN P. BEECHAM,
Secretary.

BOROUGH OF BATLEY.

TENDERS FOR GAS COAL AND CANNEL.

THE Corporation of Batley are prepared to receive TENDERS for the Supply and Delivery at their Gas-Works of 12,500 Tons of GAS COAL, and 500 Tons of CANNEL.

Conditions and Forms of Tender may be obtained on application to the Manager at the Gas-Works.

Sealed Tenders, addressed to me, and endorsed "Tender for Gas Coal" (or "Cannel," as the case may be), to be delivered at my Office by noon on Monday, July 4 next.

The Corporation do not bind themselves to accept the lowest or any Tender, and may accept any Tender for a part only of the specified Quantity.

By order,
JOSEPH HANSON CRAIK,
Town Clerk.

June 17, 1898.

BOROUGH OF BEVERLEY.

TENDERS FOR COAL.

THE Gas Committee are desirous to receive TENDERS for the supply of COAL for a period of Twelve Months from the 1st of October next, to be delivered as from time to time directed by, and at the expense of, the Contractors, f.o.b. at Keadby, or at the Pits, or at the Railway Station, Beverley, according to the Terms of Contract.

The Coal to be of the best kind, well screened, free from Sulphur, Bats, Bind, Refuse, and Dirt, and to be weighed (21 cwt. to the ton) upon the Corporation Machine.

Payments will be made monthly so long as the Contract shall be duly fulfilled.

The Corporation do not bind themselves to accept the lowest or any Tender.

Further Information may be obtained of the Gas Manager, Mr. James Gibson, at the Gas-Works, Beverley; and Tenders, endorsed "Tender for Coal," must be delivered at my Office not later than Wednesday, the 29th inst.

By order,
J. WILLIS MILLS,
Town Clerk.

Guildhall, Beverley,
June 14, 1898.

COUNTY BOROUGH OF STOCKPORT.

(GAS AND ELECTRIC LIGHTING DEPARTMENT.)

TENDERS FOR STORES.

THE Gas and Electric Lighting Com- mittee are prepared to receive TENDERS for the supply of the following MATERIALS to June 30, 1899, viz.:—

1. Bolts and Nuts.
2. Brushes.
3. Brass and Meter Fittings.
4. Cartage.
5. Casting.
6. Drysaltery.
7. Retorts and Fire Goods.
8. Glass, Red and White Lead.
9. Iron and Steel.
10. Ironmongery.
11. Lead Pipe, Tin.
12. Mill Furnishing.
13. Oils and Tallow.
14. Purifier-Grids.
15. Ropes and Flax.
16. Shovels, Pick-Heads.
17. Timber, English and Foreign.
18. Tubing.
19. Wet and Dry Meters.
20. Stationery.
21. Lime.
22. Cast-Iron Mains, 4000 Yards of 3 inch.

Forms of Tender and all further Information may be obtained on application to the Engineer, Mr. S. Meunier, Stockport.

No Form of Tender other than that issued by the Committee will be accepted.

Tenders, endorsed "Contract 1, 2, &c.," as the case may be, addressed to the Chairman of the Gas and Electric Lighting Committee, Portwood, Stockport, to be sent in on or before the 30th of June, 1898.

No Tender will be accepted, without satisfactory proof that the firm tendering pays the Standard Rate of Wages, and observes the Standard number of hours.

The Committee do not bind themselves to accept the lowest or any Tender.

By order,
WALTER HYDE,
Town Clerk.

June 17, 1898.

SOUTHPORT CORPORATION GAS DEPARTMENT.

THE Gas Committee invite Tenders for the supply of GAS-METERS—Wet and Dry—for a period of Twelve Months from July 1 next.

Tenders, endorsed "Meters," to be in the hands of the Town Clerk, Town Hall, Southport, not later than Noon, on Tuesday, July 12 next.

JOHN BOOTH,
Gas Engineer.

RADCLIFFE AND PILKINGTON GAS COMPANY.

SPENT OXIDE.

THE Directors of this Company invite TENDERS for the purchase of about 200 Tons (more or less) of SPENT OXIDE.

Samples for Testing may be taken from the heap by any intending purchaser, or will be sent, together with Particulars, on application to the undersigned.

Tenders will be received until Tuesday, July 5 next.

JAMES BRADDOCK,
Manager and Secretary.

Gas-Works, Radcliffe,
Near Manchester, June 15, 1898.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TENDERS FOR COAL AND CANNEL.

THE Directors of the Radcliffe and Pilkington Gas Company invite TENDERS for about 10,000 Tons of GAS COAL and CANNEL.

Particulars may be obtained from the undersigned, to whom Tenders, properly endorsed, must be delivered on or before Friday, the 1st of July.

JAMES BRADDOCK,
Manager and Secretary.

Gas Offices, Radcliffe,
June 16, 1898.

INNERLEITHEN GASLIGHT COMPANY.

TENDERS FOR GAS COAL AND OIL.

THE Directors of the above Company invite TENDERS for the following:—

600 Tons of GAS COAL.
250 to 300 Tons of THIRD-CLASS CANNEL.
50 Tons, more or less, of GAS OIL (Sp. gr. ·845 to ·860).

All the above to be delivered free on Rail at Innerleithen in such quantities as required during the current Year ending May 31, 1899.

Tenders to be sent to the undersigned on or before the 28th of June, 1898.

L. BELL,
Manager.

TENDERS FOR GAS COAL, &c.

THE Directors of the Oakengates and St. George's Gas Company invite TENDERS for 1600 Tons of the best screened GAS COAL, delivered free at the G.W. Railway Company's Station, Oakengates, in such quantities as may be required from June 30, 1898, to June 30, 1899.

Tenders, endorsed, and accompanied by an Analysis of the Coal offered, to be sent to the Manager on or before July 13, 1898.

TENDERS also invited for the supply of about 70 Tons of LIME for One Year.

The Directors do not bind themselves to accept any Tender.

EDWARD PARKER,
Manager.

Gas Offices, Oakengates, Salop,
June 17, 1898.

CROMER, NORFOLK.

TENDERS FOR COAL.

THE Directors of the Cromer Gas and Coke Company, Limited, are prepared to receive TENDERS from Colliery Proprietors only, for the supply of from 1500 to 2000 Tons of first-class GAS COAL, to be delivered at (*a*) the Great Eastern Railway Station, or (*b*) the Midland and Great Northern Railway Station, Cromer, between the 1st day of July next and the 31st day of May, 1899. Weight given to be stated.

Deliveries to be made in such quantities and at such times as may be required by the Company.

Payment, net cash monthly.

Sealed Tenders, endorsed "Tender for Coal," to be sent to the undersigned, on or before the 1st of July next. Forms of Tender are not supplied.

The Directors do not bind themselves to accept the lowest or any Tender.

By order,
P. E. HANSELL,
Secretary

Cromer, June 17, 1898.

THE HAVERHILL URBAN DISTRICT COUNCIL.

TENDERS FOR COAL.

THE Council invite Tenders for the supply of 1200 Tons of the best screened SILKSTONE GAS COAL, to be delivered free at Haverhill Station during the period of One Year from the 15th day of July next.

Delivery will be taken from time to time as the Manager shall require the same.

The Council reserve the right to divide the Contract into two of 600 Tons each.

The person whose Tender is accepted will be required to enter into the usual Contract for due performance thereof.

Tenders, in sealed envelopes, endorsed "Tender for Coal," should be addressed and sent to me the undersigned, not later than the 28th day of June inst.

No Form of Tender is issued.

By order,
SIDNEY H. GRAHAM,
Clerk to the Council.

Haverhill, June 13, 1898.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held MONTHLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by Auction of Gas and Water Stocks and Shares under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. Alfred Richards's Offices, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

BRENTFORD GAS COMPANY.

£15,000 OF NEW STOCK 1881.

Ranking for a Standard Dividend of 7 per cent. per annum subject to the Sliding-Scale; the last Dividend on similar Stock having been at the rate of 9 per cent.

MR. ALFRED RICHARDS will Sell the above BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Monday, July 18, at Two o'clock precisely, in Lots.

Particulars may be obtained of the SECRETARY of the Company, at the Offices, BRENTFORD; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

CRYSTAL PALACE DISTRICT GAS COMPANY.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, E.C., on Wednesday, June 29, at Two o'clock, in Lots.

£20,000 FIVE PER CENT. PERPETUAL DEBENTURE STOCK
OF THE
CRYSTAL PALACE DISTRICT GAS COMPANY,

To be created under the Provisions of the Crystal Palace District Gas Act, 1893.

Particulars at the COMPANY'S OFFICES, LOWER SYDENHAM, and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

GUILDFORD GASLIGHT AND COKE COMPANY.

MR. ALFRED RICHARDS will Sell by AUCTION, at the Mart, E.C., on Monday, July 4, at Two o'clock.

£5000 of ORDINARY STOCK
IN THE
GUILDFORD GASLIGHT & COKE COMPANY,

Ranking for a Standard Dividend of 5 per cent.; the last Dividend on similar Stock having been at this rate.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

SOUTHEND GAS COMPANY.

850 £10 SHARES.

Ranking for a Standard Dividend of 7 per cent. subject to the Sliding-Scale: the last Dividend on similar Shares having been 7½ per cent.

MR. ALFRED RICHARDS will Sell the above BY AUCTION, at the Mart, E.C., on Monday, July 4, at Two o'clock, in Lots.

Particulars at the COMPANY'S OFFICES, SOUTHEND; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

WHITCHURCH AND DISTRICT (HANTS) GAS COMPANY LIMITED.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, E.C., on Monday, July 4, at Two o'clock.

150 £10 FULLY-PAID ORDINARY SHARES
IN THE
ABOVE UNDERTAKING.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Executors of the late John Young, Esq.

DORKING GAS COMPANY.

FIFTY £25 FULLY-PAID "A," "B," & "C" SHARES.

MR. ALFRED RICHARDS will Sell the above BY AUCTION, at the Mart, E.C., on Monday, July 4, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

PATENTS, DESIGNS, AND TRADE MARKS ACTS, 1883 TO 1888.

NOTICE is Hereby Given, that William Richard Clay, of 137, Rawson Street, Farnworth, near Bolton, Co. Lancaster, has applied for LEAVE TO AMEND THE SPECIFICATION OF THE LETTERS PATENT No. 6874, of 1896, for "Improvements in, or Appertaining to, Burners for Use in Incandescent Gas Lighting."

Particulars of the proposed Amendments were set forth in the "Illustrated Official Journal (Patents)" issued on the 8th of June, 1898.

Any person or persons may give Notice of Opposition to the Amendment (on Form G), at the Patent Office, 25, Southampton Buildings, London, W.C., within One Calendar Month from the date of the said "Journal."

(Signed) C. N. DALTON,
Comptroller-General.

The Application List will open on Wednesday, the 22nd day of June, 1898, and close on or before Friday, the 24th day of June, at Four p.m.

THE HYDRO-INCANDESCENT GAS-LIGHT CO., LTD.

(Incorporated under the Companies Acts, 1862-1893.)

Working under contract with the Welsbach Incandescent Gas-Light Co., Ltd.

CAPITAL - - - £200,000,

DIVIDED INTO 200,000 SHARES OF £1 EACH.

Issue of 200,000 Shares, which are now offered for Subscription at par, payable as follows:

2s. 6d. per Share on application, 7s. 6d. on allotment, and 10s. one month after allotment.

Directors.

SIR WILLIAM ROBINSON, G.C.M.G., late Governor of Hong Kong, 53, Ashley Gardens, S.W.
HENRY A. GREIG, Esq., Chairman Limmer Asphalte Company, Limited, 2, Moorgate Street, E.C.
SIDNEY MARLER, Esq., Director, Waring & Gillow, Limited, 175 & 176, Sloane Street, S.W.
*MARTIN WASSERMANN, Esq., D.C.L. (Heidelberg), Director of Internationale Hydro-Press-Gas Compagnie, Limited, Hamburg.

*Will join the Board after allotment as Representative of the Internationale Hydro-Press-Gas Compagnie, Limited, of Hamburg.

With power to add.

Bankers: THE CAPITAL AND COUNTIES BANK, LIMITED, Threadneedle Street, London, E.C., and Branches.

Brokers: Messrs. LUMSDEN & MYERS, 29, Cornhill, and Stock Exchange, London, E.C.

Solicitors for the Company: Messrs. FAITHFULL & OWEN, 11, Victoria Street, S.W.

Solicitor to the Vendors: CLAUDE M. TREADWELL, Esq., 49, Queen Victoria Street, E.C.

Auditors: Messrs. E. LAYTON, BENNETT, & Co., Bishopsgate House, Bishopsgate Street, E.C.

General Manager: G. T. AUGSPURG, Esq. (late of the Welsbach Incandescent Gas-Light Company, Limited).

Secretary: CHARLES WEYLAND, Esq.

Offices: 88, Victoria Street, Westminster, S.W.

PROSPECTUS.

This Company has been formed for the purpose of acquiring the whole of the British, Indian, Australasian, South African, and Canadian patent rights, and all other rights incidental thereto, of the Hydro-Incandescent Gas-Light, and the benefits of the valuable license with the Welsbach Incandescent Gas-Light Company hereinafter referred to.

This Company has had transferred to it a contract and license with the Welsbach Incandescent Gas-Light Company whereby the latter undertakes, for a minimum period of five years, to manufacture and sell the apparatus; paying over to this Company, **50 per cent. of the gross profits,** not charging anything for establishment expenses, advertising, or cost of selling and placing on the market, and during the continuance of the license not to make use of any other hydraulic gas-pressing apparatus; and that, in the further event of the contract being determined, this Company is to be deemed to have a license to use the Welsbach mantles and burners, and the Welsbach Incandescent Gas-Light Company are to supply such mantles and burners at a discount of 30 per cent. from the current price.

The Hydro-Incandescent Gas-Light embodies a most ingenious, practical, and useful advance in lighting power for hotels, theatres, concert halls, shops, manufactories, railway stations, streets, barracks, docks, lighthouses, foundries, cotton and other mills, and all other places where brilliant illumination and hygienic conditions, combined with safety, are desired.

The apparatus by means of which the advantages of this light are achieved is exceedingly simple, and can easily be fitted to existing gas and water supplies. The resultant light is superior to the electric arc light, being absolutely steady and devoid of the bluish flickering glare which characterizes the latter. Notwithstanding its greater illuminating power, the light is more salutary than any other form of artificial light, owing to the fact that it more nearly approximates the sun's rays, and shades of colour are as readily distinguishable as in the daylight.

One of the effects of the hydro treatment is to remove impurities from the gas, which, under the old conditions, escaped through the flame. Another important feature in connection with the Hydro-Incandescent Light is that no covering whatever is required. It burns quite steadily and effectually, even in a dusty factory, without globe or chimney; but for decorative purposes the usual gas-globes may be employed.

Beyond the great monetary saving effected by dispensing with chimneys, and the economy of mantles, under the new system, one burner will do the work that many were required to accomplish. A single burner consuming ordinary gas as supplied from the main by a gas company can, if desired, give a light up to 1500 (fifteen hundred) candle power, at a much lower price than an electric arc lamp.

The Welsbach Incandescent Gas-Light Company use for the distribution of their goods no fewer than 16,000 agents and traders in the United Kingdom. Through the contract referred to, the Hydro-Incandescent Company will practically avoid the expenses and delays attendant on organizing an establishment of its own. Therefore, this Company **starts under the brightest auspices.**

England, without doubt, is one of the largest fields for the sale of Incandescent Burners and Mantles; and it is stated that in the United Kingdom there are over 200,000,000 gas-jets in use, and that not five per cent. of these are Incandescent Lights. The future prospects, therefore, for the Hydro-Incandescent Apparatus deserve close attention.

In addition to the income to be derived from the Company's operations in Great Britain, the Indian, Australasian, South African, and Canadian Patents are of high value, and the Directors feel confident that a considerable revenue is secured for the Company from its inception.

The validity of the letters patent which the Company will acquire has been thoroughly investigated. The following is the opinion of Mr. J. Fletcher Moulton, Q.C.:—

"I have examined the specification and claims of the letters patent granted to Rothgiesser, No. 8186 of 1897, and the prior specifications disclosed by the search in British and American specifications by Messrs. Jensen & Son, Patent Agents, and I am of opinion that the letters patent are valid and adequately protect the apparatus as made.—*Temple, 27th May,* 1898."

The purchase price of the patents and all rights for Great Britain, India, Australasia, South Africa, and Canada, together with the benefits of the license to the Welsbach Incandescent Gas-Light Company, Limited, has been fixed by the Vendors, who are the promoters, at £180,000, payable as to £113,334 in cash, and the balance in cash or partly in cash and partly in shares, or 66,666 in shares at the option of the Directors, being the maximum allowed by the rules of the Stock Exchange—leaving £20,000 for working capital.

The Vendors are also entitled, under a valuable Contract dated the 3rd day of June, 1898, and made between the Internationale Hydro-Press-Gas Compagnie, Limited, of the one part, and themselves of the other part, to an option, until the 31st December, 1898, to purchase the United States, Russian, French, Belgian, Italian, Austrian, and Hungarian patents, or patent rights, relating to the Hydro-Incandescent Gas-Light, or any of them, subject as to the United States and Belgium patents to certain negotiations which have been already entered upon by the Internationale Hydro-Press-Gas Compagnie, Limited, but the benefit of which will be assigned to the Vendors, and by their Contract with the Company they have agreed to pay to the Company 25 per cent. of the gross profits made by them on the resale of these patents, or patent rights, or any of them.

The following contracts have also been entered into:—

Contract dated the 17th day of March, 1898, and made between the Internationale Hydro-Press-Gas Compagnie, Limited, of Hamburg, Germany, of the one part, and Maurice Joseph Wells and Samuel Husbands Beckles of the other part, being the agreement under which the Vendors are acquiring the premises from the present owners, the above-named German Company. Contract, dated the 4th day of June, 1898, and made between the said Maurice Joseph Wells and Samuel Husbands Beckles of the one part, and the Company of the other part, being the contract under which the vendors sell the premises to the Company at a profit, as modified by agreement endorsed thereon, dated June 3rd, 1898, and made between the same parties. Also a license, dated the 19th day of February, 1898, made between the Internationale Hydro-Press-Gas Compagnie, Limited, of Hamburg, Germany, of the one part, and the ncaIndescent Gas-Light Company, Limited, of the other part, being the license above referred to, and as regards the interests of the Incandescent Gas-Light Company, Limited, vested in the Welsbach Incandescent Gas-Light Company, Limited.

Applicants are to be deemed to have full notice of the contents of the above contracts and license, and to have agreed with the Company as a Trustee for the Directors, and other persons liable not to make any claim whatsoever, or to take any proceedings under the Section 38 of the Companies Act, 1867, or under the Directors' Liability Act in respect of any non-compliance with the said Section, or any mis-statement in the Prospectus made by the Directors under the *bond-fide* belief that it was true.

There are other agreements and arrangements made by the Vendors in connection with the promotion of the Company and the providing of the capital thereof to which the Company is no party, which may be within the said Section 38 of the Companies Act, 1867, and applicants for shares shall be deemed to have full notice of these agreements, and to have waived all rights to be supplied with particulars of such contracts, and to have agreed with the Company as a Trustee for the Directors and other persons liable in manner above mentioned.

The Vendors will pay all costs in connection with the formation and registration of this Company down to the first general allotment of shares, except the stamp duties on the agreements for purchase and brokerage.

The Memorandum and Articles of Association of the Company, and the said Covenants and Agreements and License, together with Mr. J. Fletcher Moulton's opinion, can be seen at the Offices of Company's Solicitors.

Application will be made in due course to the Committee of the Stock Exchange for a special settlement and official quotation.

Applications should be made on the form enclosed with the Prospectus, and forwarded to the Bankers of the Company with the amount of deposit. When no allotment is made, the deposit will be returned in full; and if the number of shares allotted be less than that applied for, the surplus will be credited in reduction of the payment on allotment, and any balance will be returned.

Copies of the Prospectus and Forms of Application for Shares can be obtained at the Registered Offices of the Company, or of the Bankers, Solicitors, or Brokers.

LONDON, *15th June,* 1898.

CRYSTAL PALACE DISTRICT GAS COMPANY.

SALE BY AUCTION OF £20,000 FIVE PER CENT. PERPETUAL DEBENTURE STOCK.

NOTICE is Hereby Given, that the Directors have instructed Mr. Alfred Richards, to SELL BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on the 29th day of June next, at Two o'clock in the Afternoon precisely, in Lots, £20,000 of FIVE PER CENT. PERPETUAL DEBENTURE STOCK OF THE COMPANY, pursuant to the Powers contained in the Crystal Palace District Gas Act, 1893 (56 & 57 Vic.), and the Resolution passed at a Meeting of Proprietors.

Purchasers to make full payment before the 18th day of July, from which date Interest will accrue, payable on the 15th day of January and the 15th day of July in each year, calculated to the expiration of the preceding Half Year.

Particulars and Conditions of Sale can be obtained at the Offices of the Company, Lower Sydenham, London, S.E.; of the Solicitors, Messrs. Blyth, Dutton, Hart'ey, and Blyth, 112, Gresham House, Old Broad Street, E.C.; and of the Auctioneer, 18, Finsbury Circus, E.C.

By order of the Board,
CHARLES M. OHREN,
Secretary.

Offices and Works:
Lower Sydenham, S.E.,
May 27, 1898.

WORKMEN'S COMPENSATION ACT.

In connection with the above Act and the Employers' Liability Act, 1880, the

RAILWAY PASSENGERS ASSURANCE COMPANY

are prepared to undertake the whole liability imposed upon Gas Companies, together with the Common Law liability to the extent of Three Years' Wages.

Established 1849.

Capital fully subscribed £1,000,000.

CLAIMS PAID, CLOSE ON £4,000,000.

Particulars from W. H. HARVEY,
17, OLD QUEEN STREET, WESTMINSTER,
LONDON, S.W.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For Prices, f.o.b. Ship or Delivered by Rail, apply to
THE WALLSEND & HEBBURN COAL COMPANY, LTD.
8 Lombard Street,
NEWCASTLE-ON-TYNE.
W. RICHARDSON, Fitter.

Telephone: Castleford No. 214. | Postal Address: Castleford.
Telegrams: "Silkstone Castleford."

THE SILKSTONE & HAIGH MOOR COLLIERIES, LTD.
ALLERTON BYWATER, CASTLEFORD.
Steam, Manufacturing, & Gas Coals & Cannel.
Analysis, Contracts, Trial Waggons, and Quotations for Large and Small Orders. Inquiries Solicited.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

BOLDON GAS COALS.

ANALYSIS.

Yield of Gas per ton .	10,500	Cubic Feet.
Illuminating Power .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

For Prices, &c., apply to
W. H. PARKINSON,
THE HARTON COAL CO., LTD.,
NEWCASTLE-ON-TYNE.

Telegraphic Address: "PARKINSON NEWCASTLE."

AUTOMATIC METER REGISTER

The Meter Life Book specially adapted, and revised for "Slot" Meter Registration by

ROBERT P. KEYS.

In sizes to record 1000 Meters, with

Index, Half Bound	£2	2	0
To record 500 Meters	£1	15	0
To record 250 Meters	£1	11	6

The only Easy System yet projected.

PUBLISHED BY
WALTER KING, 11, Bolt Court, Fleet Street, E.C.

RETORT-HOUSE FITTING CO, Ld.

DE BROUWER'S
PATENT COKE QUENCHING
AND CONVEYING MACHINERY.

APPLICATIONS FOR SHARES
in this Company should be made not later than the end of this Week.
558, MANSION HOUSE CHAMBERS,
LONDON, E.C.

GAS PURIFICATION BY
HYDRATED OXIDE.

THIS Material is of full Strength, and Exceptional Activity. It is specially prepared to minimize Back-Pressure; and will be supplied on Hire, or Sold, on the most favourable Terms.

SPENT OXIDES containing Blue, also CRUDE FERRO-CYANIDE PRODUCTS, either PURCHASED or EXCHANGED for FRESH OXIDE.

MANCHESTER OXIDE COMPANY, LTD.,
CANAL ST., MILES PLATTING, MANCHESTER.

LONDONDERRY GAS COALS

FROM THE
MARQUIS OF LONDONDERRY'S COLLIERIES,
COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO
S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

THE SILICA FIRE-BRICK COMPANY,

OUGHTIBRIDGE, near SHEFFIELD,
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

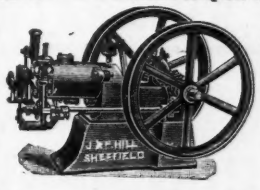
UNEQUALLED.

Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

HILL'S IMPROVED
"OTTO" TYPE GAS-ENGINES

½ H.P. to 20 H.P. Specially designed for Users of Small Power.

GAS-ENGINES & DYNAMOS complete for HOTEL, HOUSE, and SHOP Installations.



Gas-Engines and Pumps.
High-Class Workmanship.

J. & P. HILL,
Backfields & Norfolk Iron-Works,
SHEFFIELD.

FIRE-BRICKS, FIRE-CLAY, & FURNACE CEMENT.

THE
FURNACE FIRE-BRICK CO., Ltd.
(Late JAMES WHITE & CO.)
WORKS:
Longcliffe, near Wirksworth, Derbyshire.
MANUFACTURERS OF
HIGH-CLASS FIRE-BRICKS, acknowledged to be the best obtainable for
GAS, IRON, AND CHEMICAL FURNACES.

For Analysis and Prices, address—
JAMES WHITE & CO.,
WIDNES, LANCASHIRE.

HOLMSIDE
GAS COALS.

Present Daily Produce over 5000 Tons.

Latest Analysis—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation

Yield of Gas per Ton . . .	11,205 Cubic Feet.
Illuminating Power	$16\frac{7}{10}$ Stand. Sperm. Candl.
Coke (of good & pure quality)	$13\frac{3}{4}$ Cwt. per Ton.
Sulphur	A little over 1 per Cent.
Ash	Under 1 per Cent.
Tar	163 lbs. (Avoir.) per Ton.
Ammoniacal Liquor	103 lbs. (Avoir.) per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR
PELTON GAS COALS.

Present Daily Produce available 3000 Tons.

Of equal quality to the "Holmside" Coal, and also very largely used by many Gas Companies at Home and Abroad.

Both descriptions are shipped at Tyne Docks, and Dunston Staiths, River Tyne, also at North and South Docks, Sunderland.

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE & SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

EXHAUSTING MACHINERY.

OLDEST MAKERS OF ROTARY EXHAUSTERS.

WALLER'S PATENT 4 & 3 BLADE EXHAUSTERS

(3 Blade under 40,000 per Hour)

Use **LESS** Steam and give a **STEADIER** Gauge than any other type of Exhauster,

EXHAUSTERS CONVERTED TO OUR PATENT TYPE

Give **30** to **40** per cent. increased Capacity with the **SAME** Power and at the **SAME** Speed.

OVER 400 IN USE.

OLDEST MAKERS OF THE **BEALE** EXHAUSTER FOR 400 WORKS.

PATENT WASHER-SCRUBBERS, WITH WOOD CLUSTERS.

Gas-Valves, Governors, Steam-Regulators, Coke-Breakers.

CATALOGUES, PLANS, SPECIFICATIONS, AND ESTIMATES ON APPLICATION.

GEORGE WALLER & CO., 165, QUEEN VICTORIA ST., E.C.; & STROUD, GLOUCESTERSHIRE.

COAL.

THE BIRCHENWOOD COLLIERY COMPANY, Ld.

KIDSGROVE, STOKE-ON-TRENT.

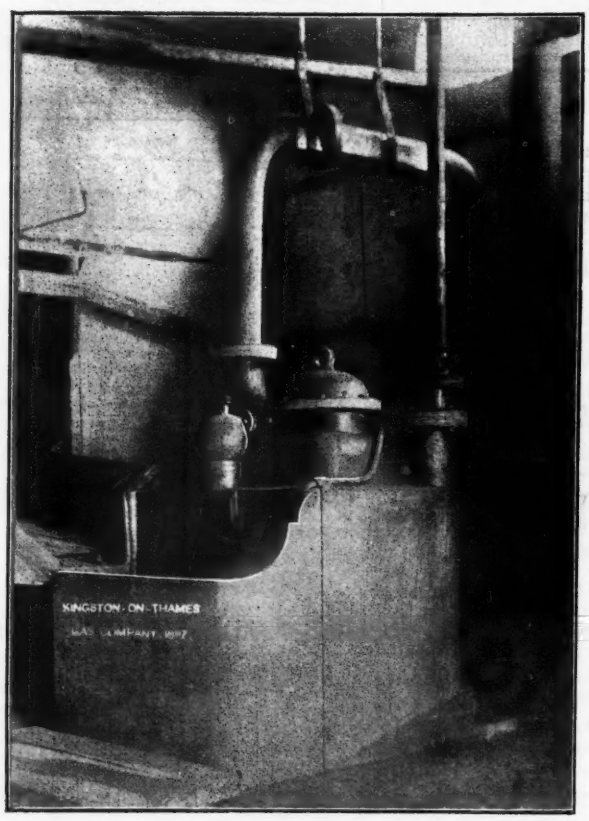
Produce very HIGH-CLASS COAL, and can supply on PROMPT and FAVOURABLE TERMS

WALLSEND COAL.
HARECASTLE—
SEVEN-FEET BAMBURY.
EIGHT-FEET BAMBURY.

BEST BIRCHENWOOD.
BEST BIRCHENWOOD COBBLES.
LARGE WASHED NUTS.
MEDIUM WASHED NUTS.

WASHED BEANS.
WASHED PEARLS.
FOUNDRY COKE.
FURNACE COKE.

Telegraphic Address: "BIRCHENWOOD, KIDSGROVE, STOKE-ON-TRENT." Telephone No. 501.



SATURATOR SUPPLIED TO THE KINGSTON-ON-THAMES GAS COMPANY.
Hand-worked from Solid Plate Lead. Two Vertical Seams only.
GUARANTEED FOR FIVE YEARS AGAINST LEAKAGE.
NOTE.—No Burning by Oxy-Hydrogen Blow-Pipe.

JOSEPH TAYLOR & CO.,

CENTRAL PLUMBING WORKS,

Town Hall Square, BOLTON.

Telegraphic Address: "SATURATORS, BOLTON."

SPECIALITIES: Solid Plate Lead Single Fishing Saturators. Solid Plate Lead Double Fishing Saturators. Circular Plate Lead Saturators for Discharging Apparatus. Timber-cased Saturators. Acid Tanks. Drainers. Sulphate-Stores. Benders of Solid-drawn Lead Pipes, any diameter and thickness.

J. TAYLOR & CO. have recently supplied, or have in hand, Saturators for the following:—

ATHERTON GAS COMPANY.
AMBLESIDE GAS COMPANY.
BOLTON GAS-WORKS.
BROMLEY GAS CONSUMERS' COMPANY.
WM. BUTLER & CO., BRISTOL.
BILSTON GAS COMPANY.
CROYDON COMMERCIAL GAS COMPANY.
CHORLEY CORPORATION. (In hand.)
COVENTRY CORPORATION. (In hand.)
DARWEN CORPORATION.
DUNKINFIELD GAS COMPANY.
DOUGLAS (I.-O-M.) GASLIGHT COMPANY.
DENABY & CADEBY COLLIERY COMPANY.
GLOUCESTER GAS COMPANY.
KINGSTON-ON-THAMES GAS COMPANY.
KENDAL CORPORATION.
LANCASTER CORPORATION.
MIDDLETON CORPORATION.
MITCHAM & WIMBLEDON GAS COMPANY. (In hand.)
NELSON CORPORATION.
JNO. PEAK & CO., WIGAN.
ULVERSTON GAS COMPANY.
UPTOXETER GAS COMPANY. (In hand.)
ROCHDALE CORPORATION.
STROUD GASLIGHT COMPANY.
SOUTHPORT CORPORATION.
TOTTENHAM & EDMONTON.
&c., &c.

ANY FORM AND THICKNESS MADE TO ENGINEERS' SPECIAL DESIGNS.

Copper Scoops, Improved Sulphate-Bagging Machines, Hydrometer Test Jugs, Hand-lifting Acid Pumps, Acid Elevators, Acid Cocks, Improved and best form of Lead-Burning Apparatus, &c.

THE WINSTANLEY

Regenerative and Generator

SPECIALITY COMPANY,

Erectors of Retort-Houses, &c., Complete.

With Special Appliances, the outcome of Years of Experience. Many complete Houses and Installations of Inclined and Horizontal Settings now in use, giving exceptional satisfaction.

Gas-Works now in course of construction by the above Company, for a make of 5 Millions per Day, complete, with Buildings, Plant, Railway Embankments, Sidings, &c., covering many acres.

DESIGNING, RECONSTRUCTING AND REMODELLING OF GAS-WORKS A SPECIALITY.

The above Company have recently Reconstructed several Gas-Works, capacity ranging from 500,000 to 3 Million cubic feet per day.

WINSTANLEY'S PATENTS.

"WINSTANLEY'S REGENERATIVE SYSTEM IS THE ACME OF SUCCESS."

NO OTHER SYSTEM ITS EQUAL IN RESULTS OBTAINED—FUEL ACCOUNT THE LOWEST RECORDED.

WINSTANLEY'S PATENT HYDRAULIC MAIN.

SHALLOW REGENERATIVE SETTINGS ALSO ERECTED.

PLANS, SPECIFICATIONS, AND ESTIMATES PREPARED ON APPLICATION.

Address G. **ATHERTON WINSTANLEY**, Kenilworth Road, **COVENTRY.**

THE DAVIS GAS-STOVE COMPANY, LTD.,

LONDON, S.E.

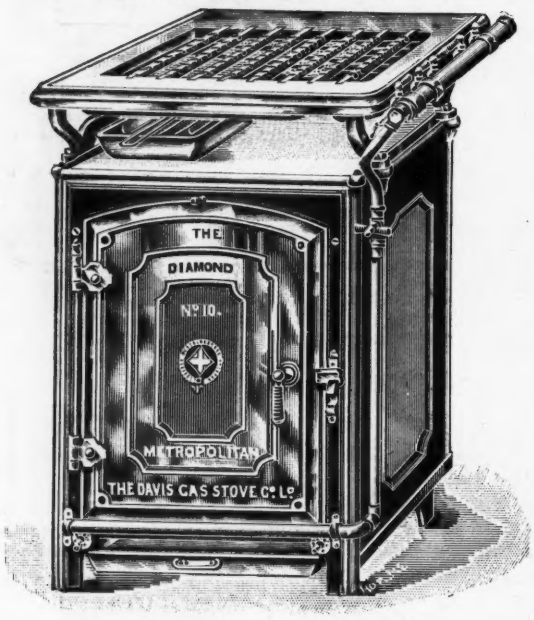
THE "DIAMOND" METROPOLITAN UP-TO-DATE COOKER.

ORDER ONE!!!

THERE IS NOTHING NEWER, NOTHING BETTER.

All Modern Improvements that ARE Improvements embodied, and new features of real value both to Gas Managers and Gas Consumers introduced. Remember that "Economy in Gas Consumption" is our Watchword.

SHOWN WITH DOOR CLOSED.



IN designing the above, we have done away with all those small loose pieces which are liable to breakage, and have kept in view the points of strength, stability, compactness, and capability of being readily repaired.

All parts are easily accessible for cleaning without the stove being disconnected; and, throughout—wherever screws are used—thick wrought-iron nuts are cast in to prevent the danger of the thread stripping.

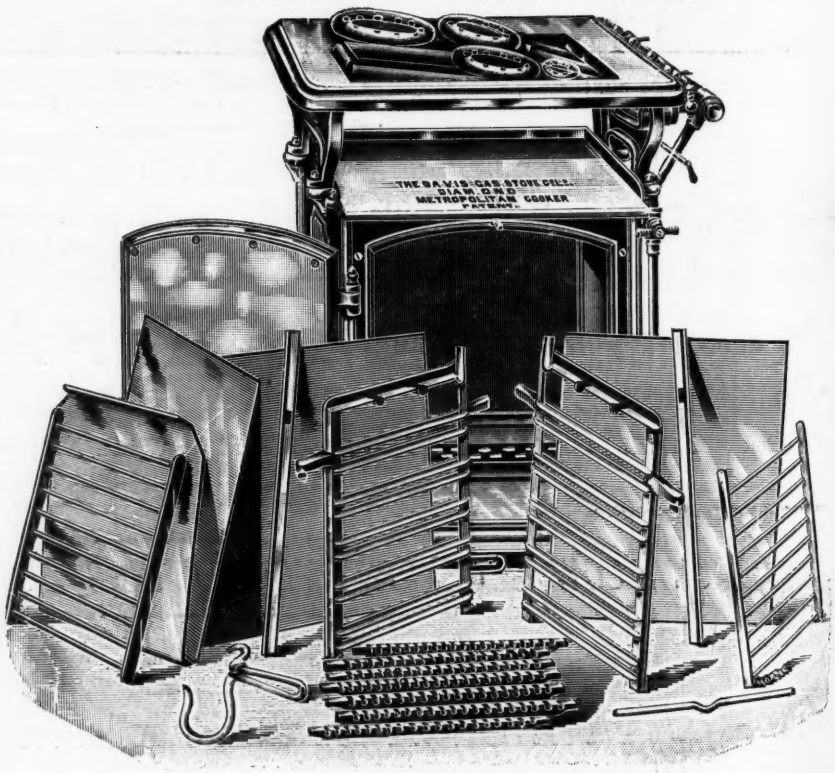
Hot-Plate Burners.—These are of cast iron and removable; but are held in position by a sliding locking bar, which holds them securely in their places so that they can be neither lifted nor shaken out when in use. They require neither cross bars nor supports (which always collect dirt and take up space) to sustain them.

Removable White Tops.—White Enamelled Top Plates are now considered an essential part of an up-to-date Cooker. This is a **really good, loose enamelled** slide-in top plate, running in a groove specially provided. It covers the **whole** of the top of the stove, and is entirely devoid of screw holes. In view of the fact that, for want of care in usage, the white enamelled tops sometimes become discoloured, while the stove is otherwise in good condition, and taking into consideration the fact that the top can only be replaced (always at considerable expense) by taking the Cooker to pieces, the improvement, by which an old plate can be exchanged for a new one at what is practically a nominal cost, is one which should carry weight in the judgment of intending purchasers, and especially in the case of Managers of Gas Undertakings.

Loose Enamelled Linings.—We have here quite a new feature, and this improvement is one well worthy of attention. It must be remembered that the body of the stove is made up of cast-iron exterior and interior plates packed between with non-conductor, and the loose enamelled linings are additional to the others. They are readily removed, and cannot become fixed, nor can they warp and so jamb the grid shelves, being automatically held in place by the hanging runners. The top of the oven is double, and packed and fitted with sliding damper to regulate the heat; and the inside top plate is studded to retain and diffuse it in the upper part of the oven. The outlet is central at the back so that flue-pipe can be taken in any direction.

The Oven Burners are loose and easily cleaned, being protected from falling fat by cast-iron splash-plates, which also prevent the bottom of the enamelled linings from becoming pulverized through the action of the flame.

SHOWN OPEN WITH ALL PARTS REMOVED.



No.	Inside Dimensions of Roaster.			Number of Burners on Hot Plate.
	Wide. Inches.	Deep. Inches.	High. Inches.	
7	12	12½	22	3
8	12	12½	24½	3
9	14	14	26½	4
9a*	..	..	..	..
10	17	17	27½	5
10a*	..	..	..	..
11*	..	..	..	..

No.	Required Space.			Prices including Deflector for Toast'g Apparatus
	Wide. Inches.	D ep. Inches.	High. Inches.	£ s. d.
7	21½	19	31	4 12 6
8	22½	20	33	5 7 6
9	25	22½	35	6 10 0
9a*	..	..	..	7 10 0
10	28½	26	36	8 10 0
10a*	..	..	..	9 10 0
11*	..	..	..	12 15 0

* These Sizes are in course of construction.

CARLESS, CAPEL & LEONARD,

HOPE CHEMICAL WORKS, HACKNEY WICK, LONDON, N.E.,

And at Pharos Works, Hackney Wick.

NAPHTHA AND GASOLINE DISTILLERS AND PETROLEUM IMPORTERS,

Specially distil Carburine Spirit, specific gravity ·680, or of any other grade suitable for Enriching Gas; also Gas Oil best adapted for injecting into the Retorts, as in the Herring Process.

Importers of Petroleum for Carburetting Water Gas, or for Manufacturing Oil Gas. Distillers of Pentane Petroleum Ether, and Naphtha for clearing the pipes of Naphthaline, &c.

Samples and Prices may be had on application.

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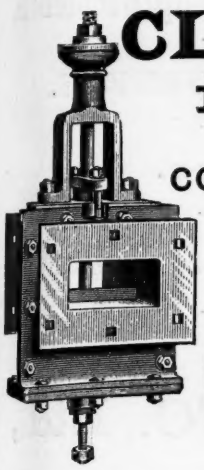
KEIGHLEY, YORKS.

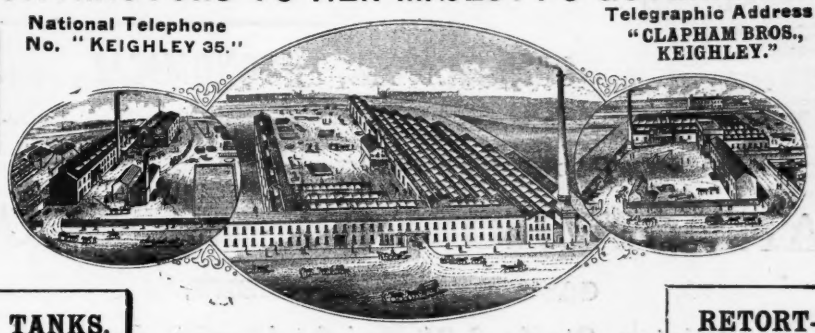
— ESTABLISHED 1837. —

CONTRACTORS TO HER MAJESTY'S GOVERNMENT.



National Telephone No. "KEIGHLEY 35."

Telegraphic Address: "CLAPHAM BROS., KEIGHLEY."



GASHOLDER TANKS, COLUMNS, GIRDERS, LAMP-POSTS, GUTTERS.

LAYCOCK & CLAPHAM'S PATENT "ECLIPSE" WASHER-SCRUBBER.

Machines supplied will deal with a total of 92,670,000 cubic feet of Gas per day.

RETORT-FITTINGS, PATENT CONDENSER, PURIFIERS, WITH PLANED JOINTS.

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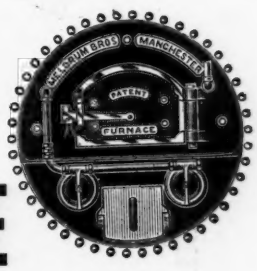
WATER VALVES & MAINS, and all kinds of Gas-Making Apparatus and General Ironwork.

"MELDRUM'S"

PATENT

BREEZE FURNACE



Now used in most of the Gas-Works in this Country for burning

COKE BREEZE, PAN BREEZE, SWEEPINGS, COAL DUST, &c.

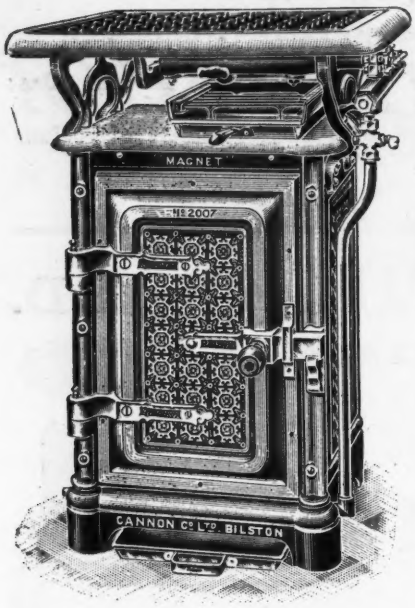
5600 in use.

MELDRUM BROS., Atlantic Works, MANCHESTER,

Also at LONDON, LEEDS, LIVERPOOL, BIRMINGHAM, NEWCASTLE, and GLASGOW.

Branch Houses at PARIS, NEW YORK, BOMBAY, TOKIO, and SYDNEY.

THE "MAGNET"



A MODERN

Gas-Cooker.

Entirely New Design, with Patented Improvements.

PATENT LOOSE OVEN BURNERS.

Marvellous Value.

ORNAMENTAL, ECONOMICAL, and PERFECT.

MANUFACTURERS:

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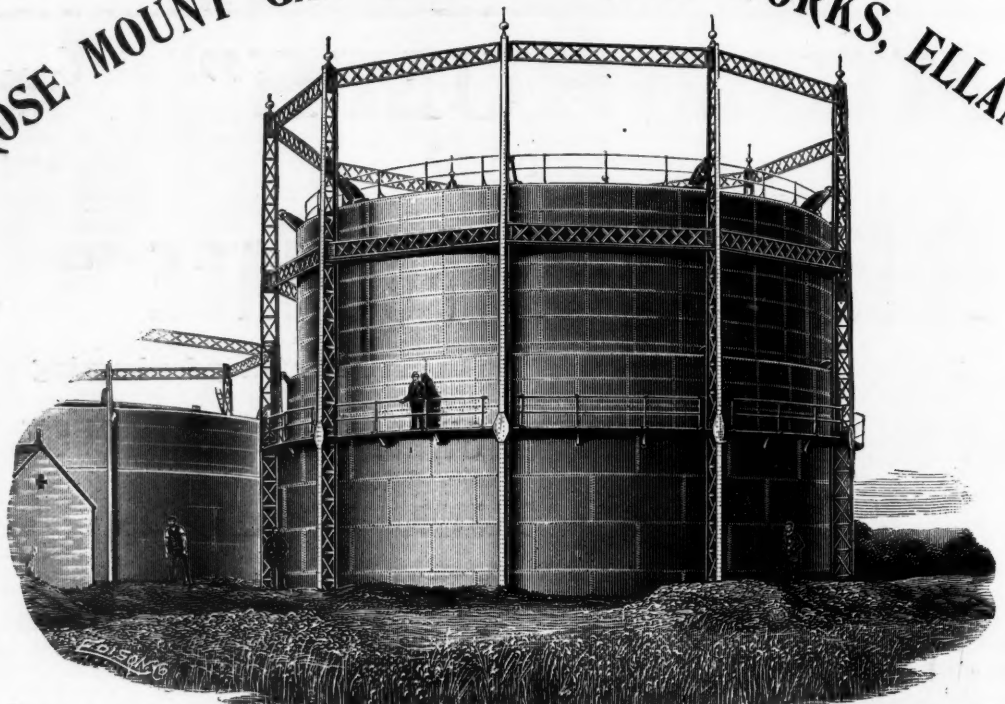
Deepfields, near Bilston, Staffs, & 61, Knightrider St., Queen Victoria St., E.C.

R. DEMPSTER & SONS, LTD.,

ROSE MOUNT GAS ENGINEERING WORKS, ELLAND.



ENQUIRIES SOLICITED.

ESTIMATES FREE.

CONTRACTORS for GASHOLDERS of any SIZE;
Also TANKS of BRICK, STEEL, or CAST IRON.

FOULIS'S

PATENT UNDERGROUND

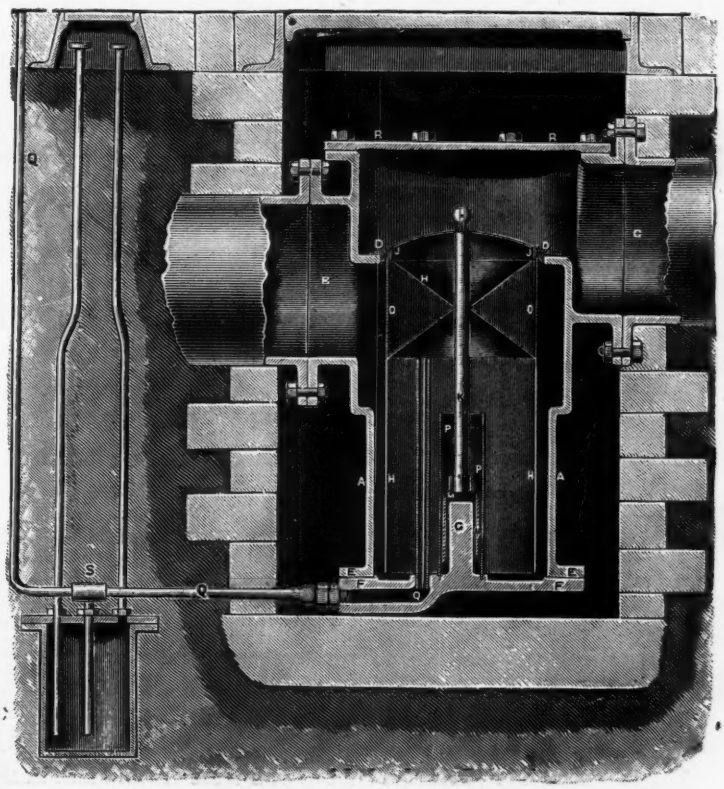
Gas-Governor

THE SPECIAL FEATURES ARE—

STEADINESS. The Piston and Barrel arrangement prevent the possibility of any sudden change of pressure. When a very small quantity of Gas is passing, the Bell cannot jump or oscillate.

SENSITIVENESS. The absence of friction, owing to the improved method of guiding, makes the Governor extremely sensitive, and removes all liability to hang or stick.

EASE of INSPECTION. By simply unbolting the top cover, the Bell can be lifted out by hand.



EASE of REGULATION. The Regulating-Bell may be placed in any convenient position (half-a-mile away from the Governor if required); the connection being made with an air-pipe.

UNAFFECTED by variations of inlet pressure.

COST. The Price is low. The Governor may be placed on the line of main, buried underground; thus saving all expense of diverting pipes. No Governor-House is required.

PARTICULARS ON APPLICATION.

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W. C. HOLMES & CO.

PATENT 'NEW' SCRUBBER-WASHER

In HORIZONTAL or VERTICAL FORM, where economy in FLOOR AREA is required.

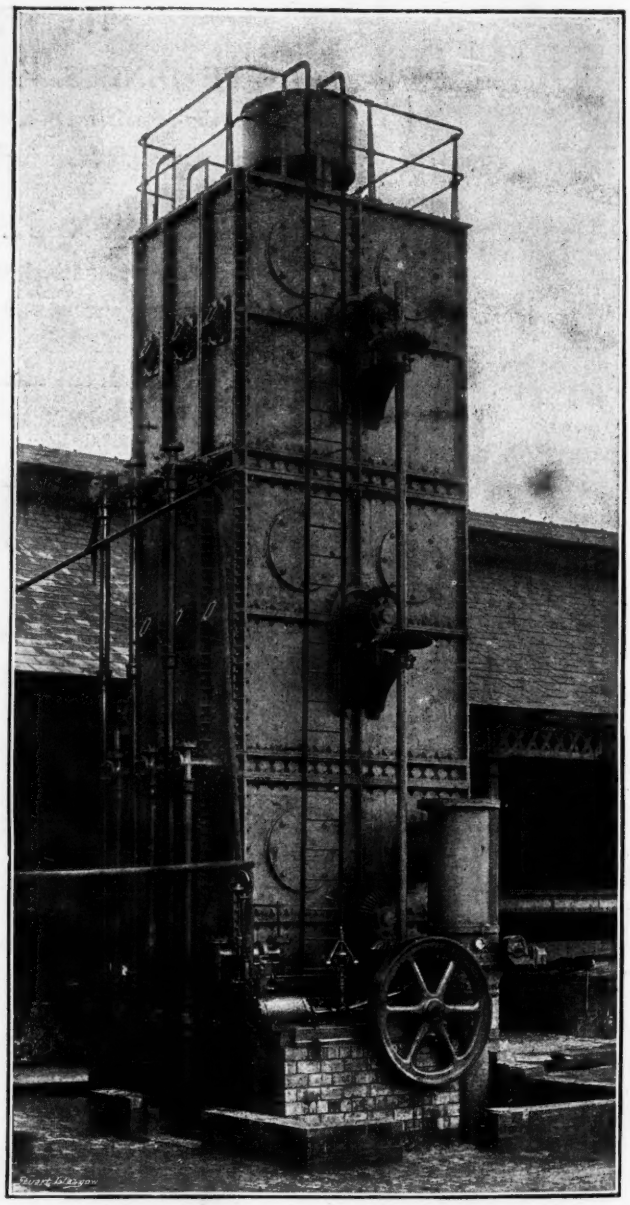
Removes every trace of Tar that may escape Condensation in the Condensers.

Complete Extraction of Ammonia from the Gas without affecting the Hydrocarbons.

Maximum Strength of Liquor obtained.

Minimum Quantity of fresh Water required.

Removal to a large extent of the Sulphuretted Hydrogen and Carbonic Acid Gas.



FROM A PHOTO.

A Machine constructed for 1,500,000 cubic feet of Gas per diem dealt efficiently with 1,800,000 cubic feet of Gas, giving only 1-inch back pressure, or 1500 cubic feet per diem, per cubic foot gross area.

The following HORIZONTAL MACHINES were erected last Year, viz.:—

KENDAL	capacity	500,000	cub. ft.	per diem.	
MORPETH	"	120,000	"	"	
SHILDON	"	400,000	"	"	
SUTTON	"	200,000	"	"	
KELSO	"	200,000	"	"	
ECCLESHILL	"	250,000	"	"	
WOODSIDE (Two Machines)	"	400,000 500,000	"	"	
BROUGHTON (Two Machines)	"	1,000,000 1,250,000	"	"	
CHATTERLEY	"	1,500,000	"	"	
WISHAW	capacity	400,000	cub. ft.	per diem.	
LONGTON	"	1,000,000	"	"	
WIDNES (Two Machines)	"	1,250,000 1,000,000	"	"	
ABERDEEN	"	2,500,000	"	"	
CARLTON (Three Machines)	"	2,000,000 2,500,000 1,250,000	"	"	
TODMORDEN	"	800,000	"	"	
TUNSTALL	"	2,000,000	"	"	

Telegrams:
"HOLMES, HUDDERSFIELD."

WORKS:

HUDDERSFIELD.

London Office:
80, CANNON ST., E.C.
Telegrams: "IGNITOR."

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GLOBE METER WORKS, **OLDHAM.**

Telegrams: "BRADDOCK, OLDHAM." National Telephone No. 254.

MANUFACTURERS OF

IMPROVED GAS STATION METERS

(OF ALL CAPACITIES UP TO 300,000 CUBIC FEET PER HOUR),

IN CYLINDRICAL AND RECTANGULAR CASES.

IMPROVED DRY GAS-METERS,

WITH "SEAMLESS" DIAPHRAGMS, IN THE

BEST CHARCOAL ANNEALED TIN-PLATE CASES

OF SUPERIOR DESIGN AND STRENGTH.

Thoroughly well made. Accurate and Reliable. Unequalled for Soundness and Durability.

BRADDOCK'S PATENT PENNY-IN-THE-SLOT

(ALSO SHILLING-IN-THE-SLOT)

PREPAYMENT WET AND DRY GAS-METERS

STRONG AND RELIABLE. DURABLE AND SATISFACTORY.
SIMPLE BUT EFFECTIVE. NO DELICATE PARTS.

No. 222.—PREPAYMENT WET GAS METER.

The Attachment does not form part of the ordinary Meter Index, and need not be taken off if the Meter has to be repaired at any future time. Hence repairs are effected with ordinary ease.

Readily changeable crown-wheel arrangement for enabling alterations in number of feet allowed per penny to be positively made *in situ*.

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SOLE MANUFACTURERS OF

BRADDOCK'S Patent "SELF-LOADING" STATION GOVERNOR

Which automatically and gradually varies the outlet pressure, within any predetermined and fixed limits, according to the demand for gas being small or large.

ALSO OF

BRADDOCK'S NEW PATENT

GAS STATION GOVERNOR

Which gives a steady outlet pressure under all conditions.

Very Extensively Adopted. *Repeat Orders Received from London and Provincial Companies.*

WILLIAM INGHAM & SONS,

Incorporated with the Leeds Fire-Clay Company, Ltd.,

WORTLEY FIRE-CLAY WORKS,
Near LEEDS,

Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—

1. Smooth interior, preventing adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
3. Uniformity in thickness, ensuring equal Expansion and Contraction.

PATENT
MACHINE-MADE GAS-RETORTS.

THE THAMES BANK IRON CO.

UPPER GROUND STREET, LONDON, S.E.,

SUPPLY FROM STOCK

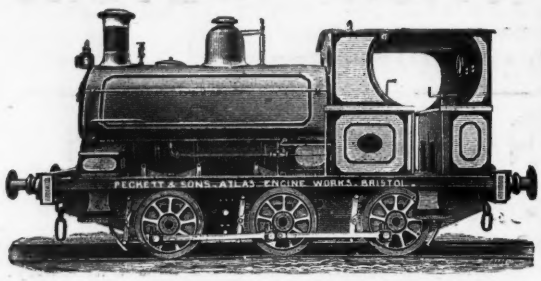
CAST-IRON RETORTS
AND ALL KINDS OF GAS-WORKS APPARATUS.

SOCKET-PIPES FOR GAS OR WATER PURPOSES.

FLANGE PIPES FOR STEAM.

Sole Manufacturers of LYON'S "PATENT" GAS-MAIN SYPHONS.

AGENTS FOR
ATTERTON'S PATENT APPARATUS for CHARGING RETORTS.



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LOCOMOTIVES of all Sizes and Gauges specially constructed for Main and Branch Lines, Contractors, Docks, Gas-Works, Collieries, Iron-Works, Brick and Cement Works, &c. Locomotives of various Sizes always in Stock, ready for Immediate Delivery.

Photographs, Specifications, and Prices on Application.

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GASHOLDER & BOILER WORKS,

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(ESTABLISHED 1765).

MANUFACTURER OF TELESCOPIC AND SINGLE GASHOLDERS,

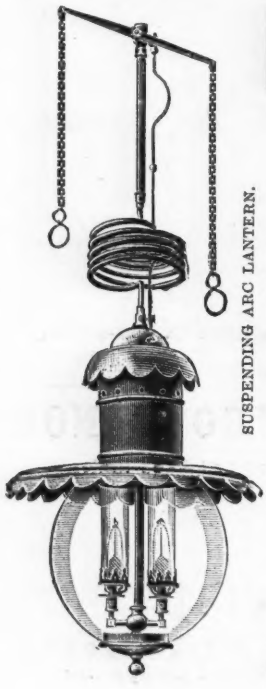
WROUGHT AND CAST IRON TANKS FOR DITTO,

PURIFIERS, CONDENSERS, SCRUBBERS, HYDRAULIC MAINS, and all kinds of GAS APPARATUS,

Wrought-Iron Roofs, Bridges, Girders, &c.,

Steam, Hot Water, and Range Boilers, Tanks, Cisterns, Boats, and all kinds of Wrought-Iron Work.

DRAWINGS, SPECIFICATIONS, AND ESTIMATES SUPPLIED ON APPLICATION.



SUSPENDING ARC LANTERN.

INCANDESCENT GAS LIGHTING

The disastrous effects of SHOCKS and VIBRATIONS may now be done away with by the use of

CLAY'S PATENT SHOCK-PROOF FITTINGS,

which are the next best thing to UNBREAKABLE MANTLES.

The Illustrations show two of our arrangements; but we are able to cope with all conceivable conditions or requirements.

WRITE FOR OUR ILLUSTRATED CATALOGUE WITH FURTHER INFORMATION.

WARNING: As we hold the Master Patents covering the COILING OF SUPPLY-PIPES to obtain a resilient bearing to neutralize the damaging effect of Shock or Vibration on the Mantles of Incandescent Burners, we shall not hesitate to immediately INSTITUTE PROCEEDINGS AGAINST ANYONE INFRINGING OUR RIGHTS.

"C" BURNER SUSPENDED WITH BYE-PASS OVERHEAD.

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(Late W. R. CLAY & CO.),

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London Representatives: Messrs. HENRY GREENE & SONS, 153 & 155, Cannon Street, E.C.

Telegrams: "CLAYS, BOLTON." See Illustrated Advt. in "Journal," Nov. 30, 1897, p. 1155.

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"HANDY" SERVICE CLEANSERS.

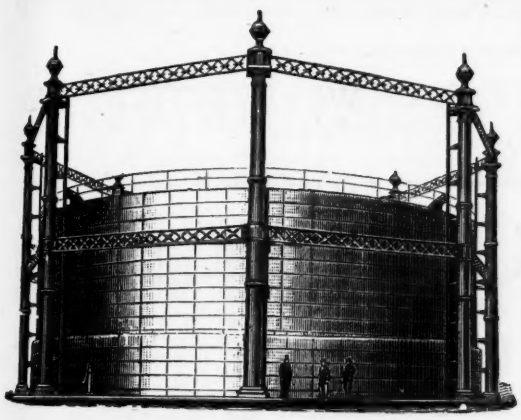
Light and Powerful. Price **50s.** each.

DRY GAS-METER MAKERS.

WROUGHT-IRON TUBES AND FITTINGS.

STREET LAMPS & COLUMNS.

Price Lists on Application.



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ESTIMATES FOR GAS-WORKS OF ANY SIZE.

References to 600 Works already erected.

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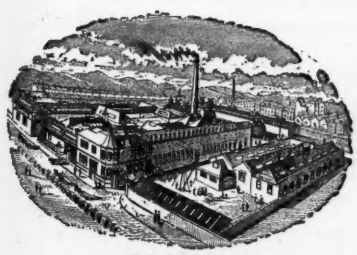
— ESTABLISHED 1850 —

MANUFACTURERS of WET & DRY GAS-METERS.

Combining all the latest Improvements.



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DRY METERS.

DRY METERS IN BEST TINNED-PLATE CASES.

DRY METERS IN CAST-IRON CASES.

(We are the Original Designers and Makers of Cast-Iron Dry Meters.)

DRY PREPAYMENT METERS ARRANGED FOR EITHER PENNIES OR SHILLINGS.

DRY EXPERIMENTAL AND TEST METERS.

Our Meters are noted for their Rigid Exactitude of Measurement, Reliability under the Extremes of Working, with Great Durability.

WET METERS.

WET CONSUMERS' METERS.

UNDERGROUND WET METERS FOR STREET-LAMPS OR OUTSIDE SERVICES.

(Dispensing with Footway Boxes or Special Lamp-Posts.)

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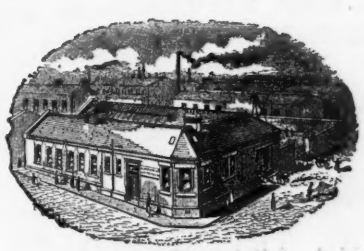

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Telegraphic Address: "ALDER, EDINBURGH." Telephone No. 81 Western. Telegraphic Address: "ALDER, BRADFORD." Telephone No. 1222.

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PATENT HYDRAULIC MACHINERY
FOR
CHARGING AND DRAWING GAS-RETORTS

SIR WILLIAM ARROL & CO., Ltd., Sole Makers,
DALMARNOCK IRON-WORKS, BRIDGETON,
GLASGOW.

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GASLIGHT & COKE COMPANY—
Beckton.

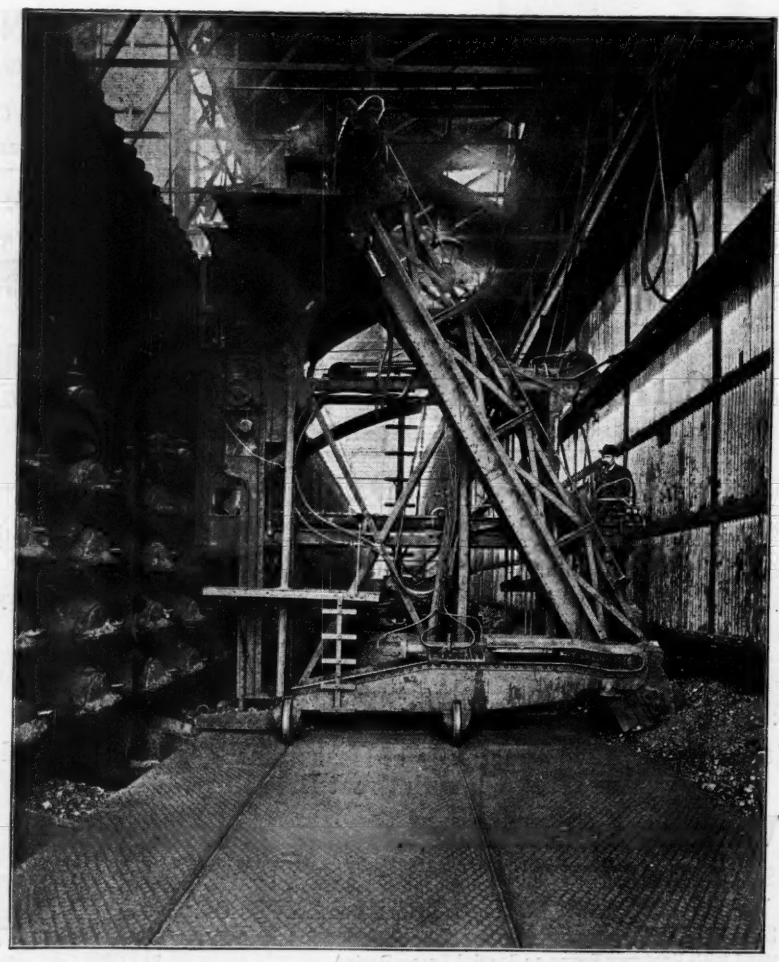
SOUTH METROPOLITAN GAS COMPANY—
East Greenwich
Vauxhall.
Rotherhithe.

COMMERCIAL GAS-WORKS—
Wapping.
Poplar.

BROMLEY GAS-WORKS (KENT).

EDINBURGH GAS-WORKS.

LIVERPOOL GAS-WORKS.



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OVER 200 MACHINES ARE AT WORK OR IN COURSE OF CONSTRUCTION.

ROTHERHITHE GAS-WORKS.

THE TIME TAKEN TO DRAW AND CHARGE EACH RETORT BY THESE MACHINES AVERAGES

ONE MINUTE.

JOHN BROWN & CO., LTD., SHEFFIELD.

Proprietors of

ALDWARKE MAIN, CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis 12,600 Feet of 19-Candle Gas per Ton.

Value in Pounds of Sperm, 820·80.

VERY FREE FROM IMPURITIES.

TELEGRAMS: "ATLAS, SHEFFIELD."

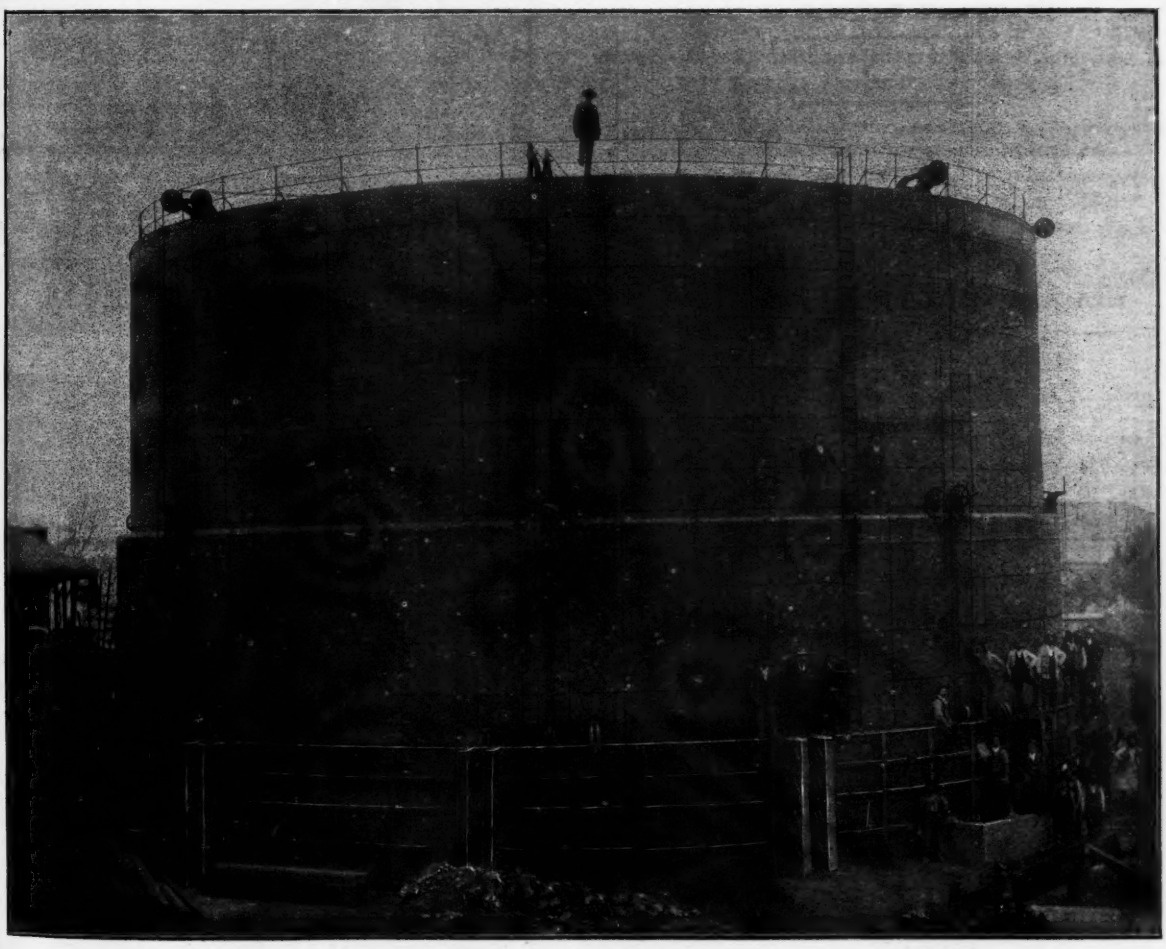
ASHMORE, BENSON, PEASE, & CO., LIMITED,

STOCKTON-ON-TEES.

Manufacturers of COLUMNLESS GASHOLDERS (Pease's System)

Great Saving in Cost, and Absolutely Reliable in Working.

Cables have now been applied to over 59 Gasholders. Makers of CONDENSERS, SCRUBBERS, PURIFIERS, and all GAS PLANT.



Valparaiso Gasholder 80 ft. diameter, with Two Lifts each 22 ft. 6 in. deep, guided by our Patent Cables.

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H. KIRKHAM & CO.'S
IMPROVED WASHER-SCRUBBERS

We guarantee every Machine to extract 20 per cent. more of the Impurities contained in the crude Gas than may be required in the application for Tenders. Please defer ordering until you have seen our Patent Washing Devices fitted in Patent Cages. Prices quoted for Washer-Scrubbers or for Renewals to all Machines of the Kirkham, Hulett, and Chandler type.

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LONDON, E.C.

HANNA, DONALD, & WILSON,

(Established 1851),

GAS ENGINEERS & CONTRACTORS,

Abercorn Foundry and Abbey Works,
PAISLEY, N.B.,

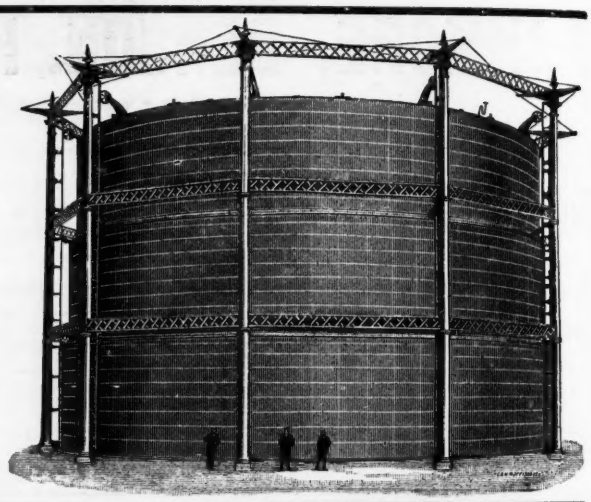
MAKERS OF

Gasholders and Gas Plant

OF EVERY DESCRIPTION.

Sole Agents for Scotland for the Automatic Coal-Gas Retort (Inclined System) Company, Limited.

Telegraphic Address: "Donald, Paisley."



THE GAS-METER COMPANY,
LIMITED,

MANUFACTURERS OF

WET AND DRY GAS-METERS, STATION METERS, GOVERNORS, GAS APPARATUS, ETC.

SQUARE STATION METERS WITH PLANED JOINTS.

STATION METERS IN CYLINDRICAL CASES.

DESIGN No. 2 PATTERN.

STATION METERS MADE AT THE COMPANY'S WORKS, OLDHAM, LATE WEST & GREGSON. Established 1830.

For Prices and Particulars apply to

R. L. ANDREWS, General Manager.

Works: 238, KINGSLAND ROAD. LONDON; UNION STREET, OLDHAM HANOVER STREET, DUBLIN.

Telegraphic Address: "METER."

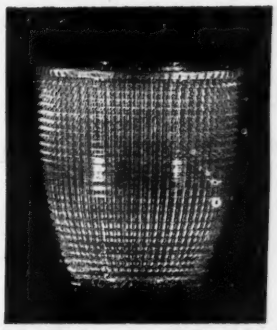
[See Advertisement on back of Wrapper.

"HOLOPHANE" PATENT LIGHT-DIFFUSING GLOBES

An immense Improvement in Street Lighting.

Thirty Per Cent. Increase in Illumination.

New Pattern No. 52 for Street Lighting with Welsbach "C" Burner.



5000 of these Globes now in use in the Streets of Munich.

No. 52, Price 1s. 6d., subject.

Mr. UPPENBORN, Lighting Engineer of the City of MUNICH, writes as follows: "You are no doubt aware that I have taken a vivid interest in your invention, known as 'HOLOPHANE' Globes. I have introduced them in Munich, and they are being used by a great many private individuals; further, in Schools; and, finally, in the 4900 Street-Lamps of Munich. By reason of the application of 'HOLOPHANE' Globes, the annoying glare of the light, as well as the shadow formation, has been entirely obviated; and we may now justly be satisfied with our street lighting."

We shall be pleased to send a sample of this Globe, free of charge, to any Gas Engineer or City Engineer on receipt of card.

Send Post Card for our latest Catalogue. All Prices greatly Reduced.

"HOLOPHANE," LTD., 91, 93, & 95, QUEEN VICTORIA STREET, LONDON, E.C.

Telephone No. 103. Telegraphic Address: "ELEVATOR, HASLINGDEN."

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ENGINEERS, HASLINGDEN, NR. MANCHESTER.

COAL AND COKE ELEVATORS & CONVEYORS.

COAL AND COKE STORAGE PLANTS.

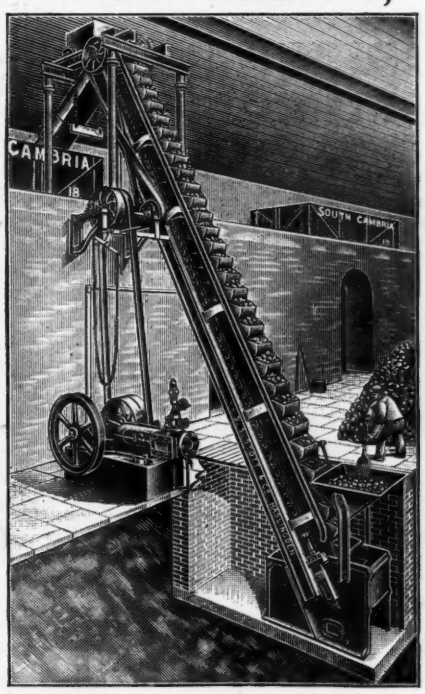
COAL AND COKE BREAKERS.

WHARF ELEVATORS FOR UNLOADING BARGES.

ELEVATORS & CONVEYORS for BOILER-HOUSES.

STAMPED AND RIVETED STEEL ELEVATOR BUCKETS.

DETACHABLE CHAINS AND SPROCKET WHEELS.



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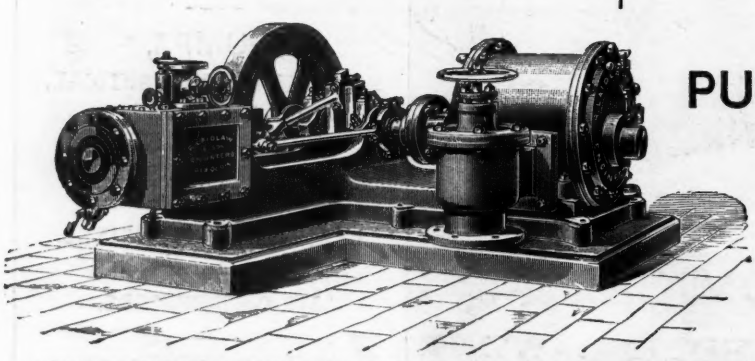

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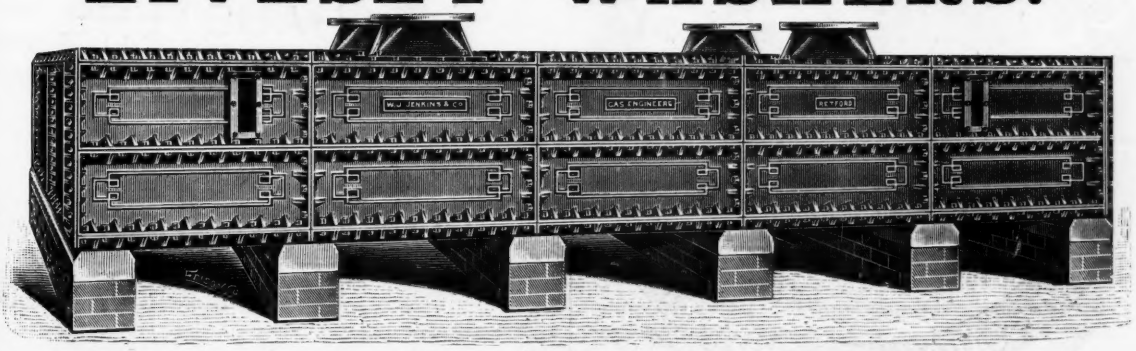

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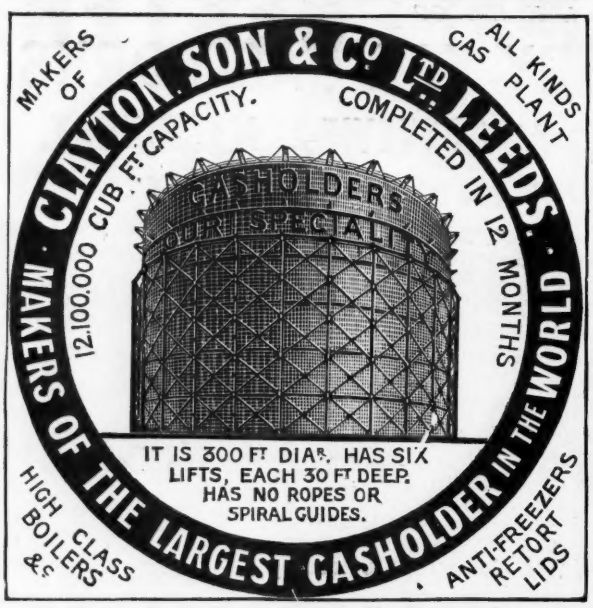
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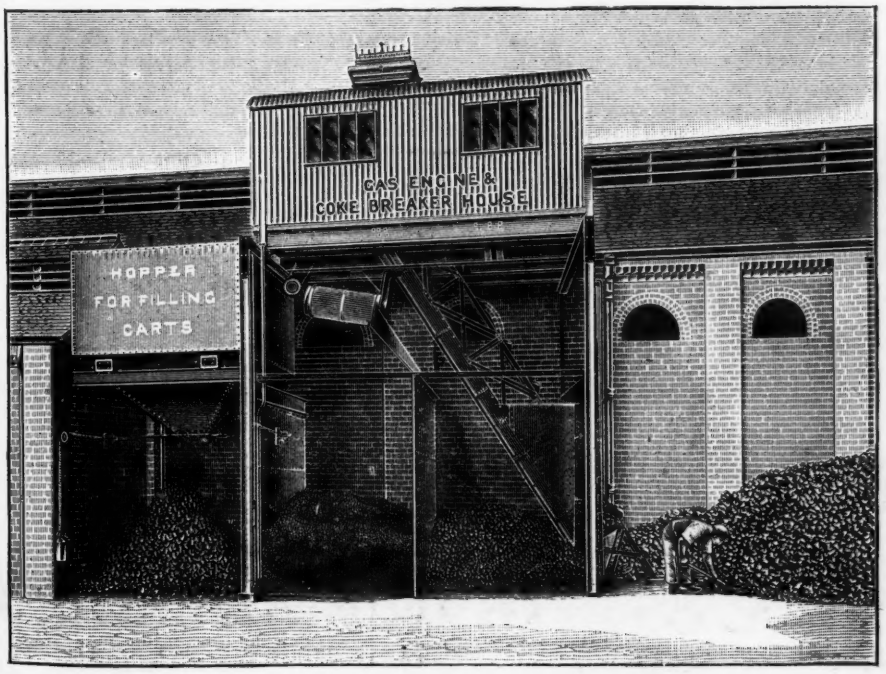

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[See also Advt. p. 1436.

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